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THE CARRARA MARBLE INDUSTRY.

THE product of the Italian quarries is known and recognized wherever marble is used as embodying all that is best and most desirable in this material. In color and texture, durability, economy in working, soundness, and capability of receiving the highest finish, it cannot be surpassed, and is rarely equaled. The so-called "Carrara district," embracing the communes of Carrara, Massa, Pietrasanta, Seravezra, Stazzema, and Arni, is the center of this industry. Carrara and Massa are the two most important, the former having a population in the city itself of 21,000 people, with an additional 21,000 in the mountain villages surrounding it and forming part of the commune. These villages are inhabited almost entirely by the quarrymen and laboring class. The commune of Massa has a population of about 24,000. Broadly speaking, the entire male population of these two communities is actively engaged in some branch of the marble industry.

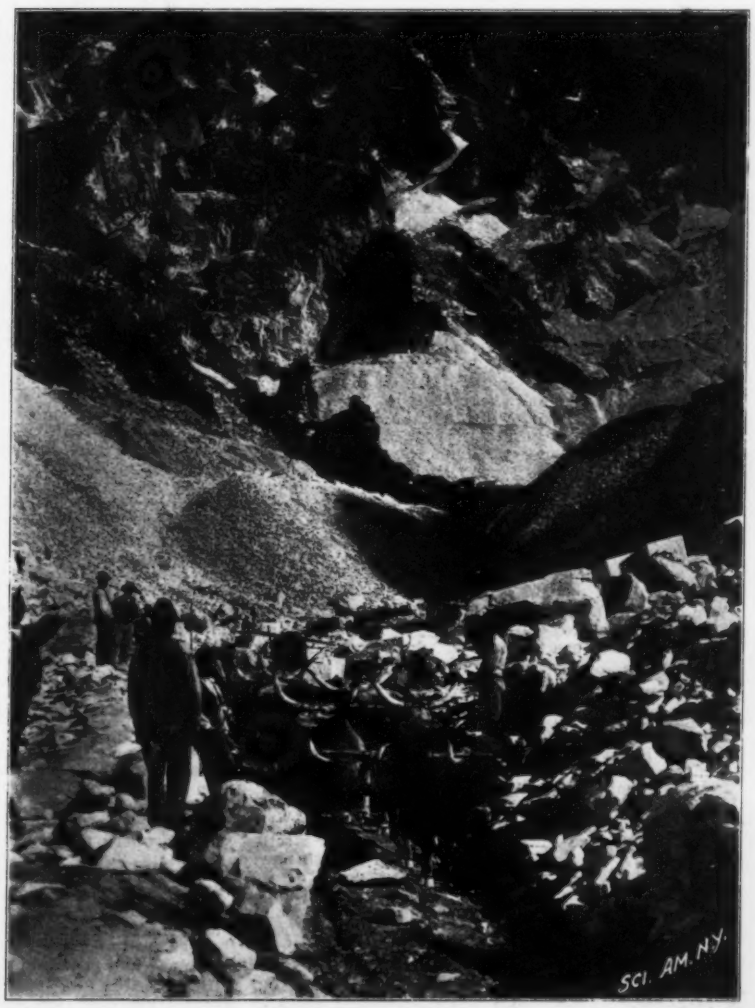
QUARRIES.

There are at present in the district 611 quarries in active operation, of which 345 are at Carrara, 50 at Massa, and the balance distributed among the places named above. In addition to these, there are perhaps double this number which have been opened and afterward abandoned as being unproductive, or in which, for various reasons, active work has for the time being ceased. Under the sanction of ancient laws, the mountains where the quarries are found are

THE MARBLE CITY OF CARRARA.

HOW THE QUARRIED MARBLE IS CARRIED DOWN.

THE RAILWAY LEADING TO THE FOOT OF THE QUARRIES.



QUARRIES AT LA PIASTRA.

THE FAMOUS MARBLE QUARRIES OF CARRARA.

the property and under the direct control of the municipality of the district in which they are located. Applications for leases are made to the syndic of the town, and within a reasonable time, after survey, etc., the concession is granted. The concession is permanent, the only conditions being that the grantee should formally renew it every thirty years, pay the annual rent, and work the property. The rent is merely nominal, some quarries producing hundreds of tons annually paying but $3 or $4. Failure to pay this for two successive years or to develop the property in the same length of time renders the concession void. Quarries thus leased may be sold or transferred, or left as an inheritance by the grantee at any time, without formal permission from the grantor.

MEANS OF TRANSPORTATION.

Until 1890, the larger part of the output was transported to the local mills or to the Marina by ox team. The Marina, the shipping point for practically all the marble intended for export, is on the sea 6 miles from Carrara. An enormous quantity of blocks and slabs is stored here. Two large piers, double tracked and with hand-power loading cranes, extend out into the sea, and a fleet of small sailing lighters load here for Leghorn, where the marble is placed on the steamers. The exposed position of the Marina renders it impossible to load during bad weather, and many vexatious delays occur in consequence.

The quarry railroad, which had been partially built and opened to traffic in 1876, was completed in 1890. This road, some 15 miles in length, is a marvel of engineering skill. It runs from the Marina to Carrara, connecting at Avenza with the Genoa-Pisa-Rome line of the Mediterranean Railroad. From Carrara, it makes the difficult ascent of the mountains, through many tunnels and over high viaducts, to a point some 1,500 feet above the sea level. Some idea of the obstacles overcome in the construction of this short road may be gained from the fact that it cost to complete about $4,000,000. Although largely patronized by the quarry owners, it has not as yet entirely supplanted the former method of hauling by ox team. The latter, however, is extremely slow, a trip to the Marina occupying the better part of a day. Rates on the railroad vary from $1.16 to $1.81 per ton of approximately 14 cubic feet for the haul to the Marina.

QUARRYING AND HANDLING.

To the ordinary observer, as well as to one well informed in the practical working of the marble quarries in the United States, the system of quarrying, handling, etc., at Carrara appears exceedingly primitive. After a visit to Carrara, one is impressed with the idea that time and money would be saved by the use of modern machinery in the quarries, the adoption of steam cranes or travelers capable of handling blocks of any size easily and quickly, and a transportation system which would not involve so many delays and the rehandling of heavy material. The impression is doubtless a correct one to a certain point, but there is much to be said in favor of the system in vogue at present, which has not changed materially for hundreds of years. The cheapness of labor, enormous cost of fuel, abruptness of ascent and consequent difficulty of access to many of the higher quarries for heavy machinery, fuel, etc., and the strong inborn opposition on the part of the quarrymen to innovations which threaten to reduce the demand for their services and to disturb the established and time-honored order of things are apparently sufficiently strong arguments to induce quarry owners to continue indefinitely along present lines.

A few years ago, a system of sawing the blocks out of the quarries by the use of an endless wire mounted on standards and pulleys, similar to those employed in some of our quarries in the United States, was introduced. Its use, however, is very limited, and but very few of the quarries have adopted it, the old method of blasting, necessarily causing a large amount of waste, being followed. Months are consumed in drilling by hand the necessary holes for the powder charges. Masses of marble often weighing 4,000 or 5,000 tons are thus loosened and thrown out from the face of the cliff at one discharge; then comes the slow and tedious process of moving this mass into position to be sawn into marketable sizes. This sawing is done by hand power also; a single, narrow iron blade fitted into a large wooden frame and operated by two men, one at each end of the frame, with the aid of water and sharp sand, accomplishes the work. Obviously, progress is extremely slow; weeks and even months are consumed in the process.

In the majority of cases, the quarries are far above the points reached by the railroad. The blocks are then placed on skids and lowered down the sides of the mountain by ropes and slings to the loading docks. Here, it would appear, derricks could be used to enormous advantage in placing the marble on the cars; but the loading is done entirely with rollers, skids, and crowbars. Blocks intended for sawing at the local mills are transported thither by either the railroad or ox team; if they are to be exported, they are sent to the Marina.

SELLING PRICES AND EXPENSES OF PRODUCTION.

So much depends on color, quality, etc., of the various marbles produced at Carrara, that it is only possible to give the range of prices approximately. The ordinary varieties are quoted from 97 cents to $1.60 per cubic foot f. o. b. Leghorn; the finer grades of statuary blocks, from $3.50 to $7. A variety known as "Bianco P," a fine white grade without veining, the best of which is produced at the Massa quarries, sells at from $1.80 to $4. The finer grades of colored marbles sell as high as $7 per foot.

In considering the cost to the exporter, many things must necessarily be taken into account. Location and proximity to transportation facilities, soundness, depth or thickness of the various veins, with consequent ability or inability to produce blocks of large size, amount of labor necessary to properly open the quarry, are all important factors. A fair estimate of the average cost of actual quarrying is, I believe, 50 cents per cubic foot. Taking this as a basis, the other items of expense are made up of hauling charges, municipal toll, dressing blocks, lighterage, etc., and the total average cost per cubic foot f. o. b. Leghorn is ascertained to be about as follows:

	Cents.
Hauling to Marina by quarry railroad, per cubic foot	11
Municipal toll	2½
Dressing blocks at Marina	3½
Loading on lighters at Marina	2
Lighterage to Leghorn	12
Cost of quarrying	50
Total cost per cubic foot	81

As has been stated, the municipality leases the quarries for a merely nominal sum; it, however, exacts a toll on all block marble shipped of approximately 2½ cents per cubic foot, and on sawed slabs at the rate of 7 cents per ton, or half a cent per cubic foot. Manufactured marble, statuary, and the like are exempt from this tax.

COLORED MARBLES.

Many varieties of colored marbles are also found on the mountains surrounding Carrara. Two varieties of blue, dove-colored marble, known as "Bardiglio" and "Pavonazro," are well known in the United States, the latter especially being largely used and commanding a high price. Some new and very beautiful fancy marbles have recently been discovered near the villages of Gragnana and Castelpoggio, north of Carrara. In the vicinity of Castelpoggio, a very fine variety of red marble is quarried. Some varieties of the well-known black-and-gold marble are found at Monte d'Arni and Foce, near Carrara. It is similar to that found at Porto Venere, in the Gulf of Spezia, having a densely black ground crossed in all directions by yellow veins. Besides these colored marbles, some fine onyx has been discovered at Monte d'Arni. These quarries are not now in active operation, it being found unprofitable to work them under present conditions. The merchants and explorers of Carrara also deal largely in the well-known Siena yellow marble and the various varieties of Numidian marbles. The latter are brought from the quarries back of Oran, on the northern coast of Algeria.

The extent of its commerce with all nations in its own particular line, with the variety, quality, and beauty of its marbles, justly entitles Carrara to stand at the head of the marble-producing centers of the world. It has occupied this position for centuries and bids fair to continue to do so for many more to come.

THE MINING AND WORKING OF GOLD.

THE use of gold is one of the most ancient of industries. The Romans secured the precious metal from the mines in Hungary, which are being worked to this day, while some of the deposits in Wales have been worked for centuries. The many ways in which gold is utilized may possibly be best shown when it is stated that between the years 1850 and 1870, from one hundred and fifty million to three hundred million dollars' worth annually was secured by the miners. Gold exists in nearly all portions of the earth, but has been found in the largest quantities in the northwestern part of America, on what is called the Pacific coast, in Australia and South Africa. It exists in what the geologists call "tertiary gravel," also in various rock formations. It can also be extracted from the common sea-water, and has been found in volcanic lava. The origin of gold has been much discussed by geologists, some believing that it was produced by the action of fire upon various materials comprising the earth's surface, while others have claimed that it was deposited from the action of water in decomposing rock and other formations. The metal has been secured in a variety of forms from "paint gold," so small that the scales can scarcely be seen with the naked eye, to nuggets or lumps. The largest nugget ever discovered is known as the "Welcome," and was taken from the mines at Ballarat, Australia; its actual weight was 2,217 ounces and 16 penny-weights, and it sold for fifty thousand dollars.

The gold found in gravel is secured by what is called placer mining and is sometimes called "placer gold." The gravel frequently forms the bed of streams which have become dry, and holds the metal in the form of scales, dust and fine nuggets.

Many of these rivers became dry centuries ago, and their beds have been filled with deposits of earth and rock, sometimes a hundred feet deep and more. To extract the gravel, the miners dig into the side of the hill, and try to follow up the dry bed of the stream under the mass of earth and rock. These deposits are sometimes called "leads" by the miners, who try to trace their direction or drift to avoid the removal of extra material which may cover them. Some of the richest deposits in California and Australia, as well as the mines of the Transvaal, are composed of deposits of this kind. A large amount of the metal is also yearly extracted from the beds of running streams, especially on the Pacific coast and in Australia. This is called alluvial gold, and is secured by washing the sand and gravel which holds it, thus separating the particles of metal. One mode of washing is to take a quantity of the "pay dirt" in a pan and pass water through it, dissolving the earthy matter. Sometimes the dirt is treated to action of water flowing through a trough or sluice which removes the dirt, the metal falling to the bottom. In the beds of some streams in South America and Australia, large dredges are employed, which shovel or scoop up the material from the bottom and deposit it in receptacles, where the gold is extracted by the washing process.

Hydraulic mining is another form for extracting the gold from the gravel and sand deposits. Water from a reservoir or some other source is thrown against the bank in a powerful stream through a line of hose with such force that the embankment becomes loosened and falls into a trough or sluice, along which it passes, the metal it contains being gradually separated from it by the action of the current of water. By this process hundreds of tons of gold-bearing material can be treated in a day.

Vein mining is the term applied to the extraction of the gold found in rocks. Most of these formations are so hard that water has very little effect. Consequently they are dug out with pick and shovel and sometimes blasted with explosive, as in coal mining. The ore is then taken to the smelter or reduction plant, where it is usually roasted by being placed in a receptacle and treated to intense heat, which allows the rock to be easily broken. In this form the ore is conveyed to the stamping mill.

The modern plant of this kind is located near the roasting furnace, so that the ore can be taken to it at once. Here it passes between sets of steel rollers of various sizes, which crush it until it finally comes out in the form of a powder. In this form it is conveyed over plates or troughs containing mercury, which has an attraction for the gold and catches it, or "picks it up," as it moves over the plates. The powdered rock and other foreign substances are "tailings."

Sometimes these are again treated, as they contain a small amount of metal which escapes the mercury in the trough. The gold is separated from the tailings by passing the material through a series of screens and sieves, and again exposing it to the contact of the mercury. If iron in the form of pyrites is present, the roasting of the ore causes the gold to become coated with a chemical product of the pyrites, which must be removed. The principal impurity is found in what is termed sulphuret ore, due to the amount of sulphur it contains. The application of heat converts the sulphur into acid, leaving the residue in the form of "cinders." The metal is further purified by combining it with chlorine and then washing with water. The chlorination process can be used for extracting the gold from very poor ores, or low-grade ores as they are sometimes termed, and has rendered many deposits, which have hitherto been considered valueless, of commercial value. In this country and in England attempts have been made to secure the small percentage of gold in solution in sea-water, but thus far the experiments have not been sufficiently successful to carry this on as a business. The general plan followed has been to really decompose the water by chemical action, thus securing the metal.

Gold is the most malleable substance known, and is one of the most ductile of metals. These qualities, in addition to its brilliant luster and rarity, have combined to make it of such great value for various purposes. It has been used in making ornaments to wear on the person since the days of the ancient Egyptians, who were among the most expert workmen. The Greeks were noted for applying it in ornamental designs connected with statuary and other arts. Etruscan gold work has been known for centuries because of its excellence, and for a time was considered one of the lost arts.

Gold is so malleable that it can be flattened into sheets which are actually but one two-hundred-and-fifty-thousandth of an inch in thickness. Gold leaf, which is one of the most common forms in which the metal is used, is not composed of the pure gold, but a mixture of 70 per cent gold and 30 per cent silver, which is melted together, forming what is called an alloy. Coming from the crucible in the form of ingots, it is rolled by machinery into lengths of ten feet each. These are cut into square pieces and placed in a pile between leaves of heavy paper and skin to be pounded with a hammer weighing seventeen pounds. By this force each piece is lengthened and thinned. The pieces are again divided into four parts and beaten with a smaller hammer. After being subjected to this treatment for four hours, they are cut into four parts again to be beaten with a seven-pound hammer, when they emerge in the form of gold leaf or foil as we know it. Gold beating is generally done by hand, and gives employment to a large number of persons, but requires much practice before one becomes skilled in it, simple as the process seems to be. The ductility of the metal allows it to be drawn into a wire so fine that one grain has been stretched to a length of five hundred feet without breaking, and so strong is it that a wire less than one-tenth of an inch in thickness will support a weight of one hundred and fifty pounds.

In the manufacture of wire the gold is usually mixed with copper or silver to form alloy, and rolled into rods about one and one-half inches in diameter. It is then heated on burning charcoal or in some other manner and drawn. The usual manner is to pull it by hand or machinery through a hole of a certain size. In this form it is again heated, drawn through a second hole somewhat smaller, and thus the process is repeated until the required size is reached. The draw table of the hand workman is provided with a wheel containing a handle and a hollowed rim. The end of the wire as it passes through the hole in the draw frame is wound around the wheel, and the workman's strength assisted by turning the handle of the wheel. The draw frame is usually made of very hard metal to resist the friction, but the hole soon enlarges, and another gage must be provided. In the manufacture of very fine wire, diamonds and rubies are pierced with a hole of the proper size, as they are so hard that they will better withstand the wear of the process. The amount of wire which can be produced from a single ounce of gold alloy seems almost incredible. A lump of this size is frequently drawn out to fourteen hundred yards, while two thousand yards have been produced by this process.

The very fine wire is used largely in the manufacture of gold lace, but most of the wiring which forms this material is really made of silver or copper alloy by the process described, and covered with the gold leaf for economy. The alloy is prepared in the form of rods ranging from one to two inches in thickness, although the usual size is about one and one-half inches. The alloy consists of one part of silver to forty or sixty of copper. It is heated over burning charcoal, and the leaf applied in this form. After being coated or plated, the rod is smeared with wax and ready to be drawn into wire. Even the size which represents two thousand yards to an inch can be wound or spun over fine silk by machinery which has been invented for this purpose. It is called a spinning engine and performs wonderful work, completely covering the silk with this microscopic wire. This is the gold thread, as it is known, which is largely used

for the manufacture of gold lace, is woven into the fabric known as cloth of gold, and employed for making uniforms and regalia.

In ornamental work gold leaf is very popular, as such a small amount of it can be used for a covering. It is employed to coat wood, leather and even some kinds of metals. In gilding picture frames and other wooden work, it is laid on the surface with a brush made especially for the purpose. After this it may be covered with a varnish or some other liquid which preserves it from becoming discolored. A wash gilding, as it is called, is prepared by mixing gold and mercury in the form of a paste. It is then applied to the surface of the material to be covered, and the mercury in the amalgam, as it is called, evaporated or driven off by exposing the coating to heat. In this manner the gold is utilized in the manufacture of bric-a-brac and other ornaments. Steel can be gilded by applying the metal in a solution of chlorine known as terchloride of gold. The production of images owes much to this discovery, while silks and other fabrics, artificial flowers and even bone, can be ornamented with the same composition, although the application of hydrogen gas is required to complete the process.

Jewelry, as we know it, represents so many varieties as to be indescribable. It may be in the form of a ring or a watch case. The latter represents the malleability of the metal, as it is merely a sheet of gold pounded and bent into shape. The ring may be merely a piece of small wire or a hoop. Perhaps the most interesting example of the ductility is in the making of watch chains, where the links are bent into a variety of shapes and yet will sustain a hundred pounds in weight, such is their strength, and can be worn one's lifetime without needing repairs. The ancient manner of producing gold ornaments was to hammer the lumps or ingots into the desired shape. Later the art of wire drawing and gold beating became prevalent, and thousands of articles could be made from the sheets and wire. The Hindoos were among the earliest goldsmiths in wire or filigree work, and some of their designs in rings and other ornaments are actually marvelous. In addition to forming objects of jewelry, the metal can be ornamented by chasing or engraving, also by enameling.

The engraver's tool, as it is called, is made of steel hardened by tempering, so that it cuts into the surface of the gold as easily as the boy draws marks upon his slate with a pencil. By its use, the engraver produces landscapes, faces and a hundred different designs and ornaments upon the face of the watch case or the locket, which will remain for years before becoming indistinct. The Etruscans of Southern Europe, it is believed, created the art of enameling. Enamel is composed principally of colorless glass as the base. It is melted in a furnace with various forms of metallic oxides, which give it the hue desired. The compound is then cooled and ground to powder. In this condition it is applied to the surface of the gold, and made to adhere by being fired or heated in a furnace specially built for the purpose. Enamel can be produced in all the principal colors by merely fusing the glass with the proper oxide.

To determine the correct proportion of gold in a quantity of ore, has led to the development of the process of assaying. The ore to be tested is roasted in an open dish in what is called a "muffle furnace," in order to render the rock friable. The "sample," as it is called, is first carefully weighed on scales especially built for the purpose. After roasting, it is mixed with a quantity of borax and from ten to twenty times its weight of lead. It is then treated to what is known as the "cupellation" process, being placed in a cupel or vessel which is porous, and melted. The cupel being porous absorbs the oxides, leaving the gold and lead in the form of what is called a button as well as a slag. A portion of this gold and lead alloy, usually a few grains, is wrapped in a small quantity of sheet lead and melted again by exposure to heat for about twenty minutes. As but a very small percentage of gold ore contains the metal pure in its natural state, tests have to be made to detect the presence of silver or other substances, which are generally found after cupellation. What is known as inquartation is the principal method employed. The piece which is supposed to contain silver is melted in a cupel with from two and one-half to three times its weight of silver, and the product thus obtained is brushed to remove all impurities from the surface, flattened by rolling or hammering, and drawn into a ribbon or wire. A section of this is placed in boiling nitric acid, which indicates the presence of silver by separating the metals, and the proportion of silver found determines the assay. As so much gold is employed in making coins, the assay apparatus used by the governments of the United States and Great Britain and other countries is very complicated in its working, but in general the plan described is the one followed. The importance of the process is very great, as mining property is frequently sold or appraised upon this estimate of the ore, while all gold which has been extracted from the ore, and bullion or bars to be made into money or other articles, is assayed before being sold or manufactured.

Gold coin represents the highest value of money throughout the world, and determines what is known as the standard of value. In its pure state the metal is too soft to be thus converted, and is mixed with some other substance, usually copper or silver. The eagles, double eagles and other coins which come from the American mints contain about ninety-two per cent of pure gold, the rest being copper. The coin of Great Britain is produced from ninety per cent gold and ten per cent copper, the latter metal giving it more wearing qualities, as the frequent handling constantly rubs the surface. The gold and other coin are manufactured in this country at what are known as the mints. The principal ones are located at San Francisco, Philadelphia and Washington. Formerly the coin was minted by the design on each side being cut out of the metal or pressing it into the surface of the alloy with a steel die containing the shape of the design. By the invention of a French workman, named Thonnelier, the coining presses which are now used by the United States were made practical. The disks of alloy or "blanks" are placed in position by the operation of the machine, and the face of the die pressed upon them by the action of a lever. This is called the stamping process, and so perfectly is it done that although a thousand may be completed in a few hours, one cannot detect any difference in the size of the coins or the marks on their face, even with the microscope. The face of the die is, of course, just the reverse of the impression to be made on the face of the coin. All lines which appear raised on the coin are depressed in the die, and marks which are sunk into the coin project from the surface of the die. It is manufactured of steel made especially for the purpose, and by machinery so exact that the variation of a ten-thousandth of an inch can be detected. The government reserves the right by law to make or coin money, and anyone who attempts to do this even out of pure gold is called a counterfeiter and considered guilty of a crime.

The discovery of gold has made very important changes in the parts of the world where it has been found. The first in California was picked up in the form of grains by Mr. J. W. Marshall, in 1848, while digging a waterway for his mill. It led to many thousands going to the Pacific coast from the eastern part of the country, and changed California, Oregon and Washington from a wilderness into a civilized country. The discovery of gold in South Africa and Australia caused over a hundred thousand people to go to these countries from other parts of the world. Within the last few years gold has been found in the territory of the United States known as Alaska, and more recently at Cape Nome, where the miners have been obliged to melt the snow and thaw the frost out of the ground in order to dig for it, so cold is the climate. By use of the modern crushing mill chlorination process, a number of mines in Georgia, North and South Carolina, Virginia and New Jersey are now being worked profitably, which for a long time were abandoned because the ore yielded such a small amount of pure metal.

The United States produces about 3,300,000 ounces of gold from veins yearly, and 600,000 ounces of gold from sand and gravel. The mines of Colorado are the richest in vein or quartz gold. This state yields about 1,400,000 ounces a year. California averages about 600,000 ounces of quartz gold annually. The production of gravel or placer gold is much smaller than of quartz gold in each State. The Territory of Alaska leads in this mining with about 300,000 ounces yearly. The total value of gold mined in this country in a year ranges between $75,000,000 and $100,000,000.

PLATINUM.

PLATINUM is one of the metals diligently searched for without cessation, if with only moderate success.

Prof. J. F. Kemp discusses in Bulletin No. 193, of the United States Geological Survey, now in press, the "Geological Relations and Distribution of Platinum and Associated Metals." He sets forth the chemical relations of platinum; its minerals and their chemical composition; the other minerals associated with it, either as constituent parts of the nuggets found, or accompanying it in gravel deposits; the occurrence of platinum in country rock, and in copper ores of various countries; the occurrence of platinum in Australian coal, in meteorites, and finally in the sun.

He then passes in review the localities where platinum has been discovered. Beginning with North America, he notices the occurrence of traces or small quantities of platinum found in Quebec, in the form of sperrylite in Ontario, and describes at length the occurrence of platinum in commercial quantities in British Columbia, on the Tulameen fork of the Similkameen River, in the region of the town of Princeton, some thirty or forty miles north of the international boundary on the east side of the Cascade Mountains. The area of chief interest is in the valley of State Creek and along the Tulameen River below its tributary, Eagle Creek.

Turning to the United States, he reports the occurrence of platinum in small quantities in the gold sand of California and Oregon, and notes the actual or the reported occurrence of the metal in Arizona, Colorado, Georgia, Idaho, Montana, New York, North Carolina, and Pennsylvania. He notes also the reported occurrence of platinum in Mexico, Honduras, and Santo Domingo, and its reported occurrence in veins in Brazil. He discusses the placer deposits of Colombia in El Choco district on the San Juan River, in the western watershed. Colombia now ranks as the second producer of commercial platinum.

A few scales of platinum have been discovered in gold-bearing sands at Ollalipian, in Siebenburgen, Austria. In France, also, platinum is occasionally seen at Morbihan, in Brittany; at Gard, in Cevennes; in several localities in the Departments of Charente and Deux-Sevres; on the Chapeau Mountain, near Chatelard, Hautes Alpes; near Presles, in Savoy; and in a few other places. In Germany, it is reported in the Hartz Mountains, from the Siebengebirge, and from Freiberg. In Great Britain, a few grains of platinum have been observed in the gold-bearing sands of Wicklow, Ireland; on the island of Jersey; and in the sands of the River Urr, Kirkcudbrightshire. None of these sources furnish commercial platinum.

Nearly all the commercial platinum comes from Russia, where the productive districts lie along the eastern watershed of the Urals, in the eastern portion of Perm in Kasan, and on the western watershed farther south. A few years ago the greater part of the platinum came from the district of Nijni-Tagilsk, nearly due east of the city of Perm; but now the largest supply is obtained in the Goroblagodat and Bisersk districts, about 130 miles farther north and northeast of the town of Nijni-Tagilsk. From the watershed of the Urals, two small rivers, the Iss and the Veeya, flow eastward and join the Tura River, and the productive platinum ground, about 2,000 square miles in area, is found along the Iss and the Veeya, and on the Tura. The platinum is found in gravel in the placers, both in the beds of the streams and above water level. Platinum is reported in a number of other places in the Russian empire.

Platinum was found in small quantities in Spain, near Seville; and it has been found also in Borneo, in Burma, in Japan, in New South Wales, in New Zealand, and in Tasmania.

With regard to platinum in the United States, Prof. Kemp says that the most productive deposits are in California, in Trinity County, along the Trinity River, three to four miles below Junction City; but that the annual product amounts to only a few ounces. He quotes from a paper by Dr. David T. Day summarizing the results of a careful investigation of the platinum resources of California. Dr. Day says that the Pacific beach mines of Gold Bluff, Arcata, Big Lagoon, Stone Lagoon, Little River, and Crescent City, California, and of Gold Beach and Port Oxford, Coos County, Oregon, have all yielded platinum in commercially appreciable quantities; that most of the platinum product has come from the inland diggings, where the grains are comparatively coarse; and that it has become well known in the placers of the American River, and in Plumas, Shasta, Trinity and Siskiyou Counties, California. The Bee Gum district, in Shasta County, the Hay Fork district in Trinity County, and the deposits along the Trinity from Chapman's mine, south of Junction City, northward to beyond North Fork, are most promising.

The remarkable nugget of platinum found about 1880, near Plattsburg, New York, was clearly brought, Prof. Kemp thinks, by the glacial drifts from the north, possibly from the areas of serpentine in Quebec, north of Vermont.

The arsenide of platinum, sperrylite, has been found in North Carolina, and has been traced to the mother rock, a ledge on the top of Mason Mountain, near Franklin, in Macon County.

Prof. Kemp concludes that platinum is very sparsely distributed in its mother rock and that the chances of finding it in quantities sufficient to mine are small; but that there is a chance. He thinks that large and permanent placers are to be looked for only in very old land areas, which have been subjected to protracted degradation and concentration; that in the assay of antimonial, arsenical, and other copper ores, but especially of gray copper (tetrahedrite), it is worth while to look for small percentages of platinum; and that deposits of chromite deserve similar testing for platinum.

THE FORUM EXCAVATIONS AT ROME.

THE cleaning up of the ground between the Temple of Castor and the Augusteum of Hadrian (in fact, the commencement of the Nova Via) has brought to light several more important architectonic fragments of the first-named shrine. These include two bases of columns, as well as a capital, and part of a fluted column. But a more important fragment than even these was found covering over a drain hard by them. There is 8 feet in length of it, and it forms the southeastern acute angle of the pediment, including, of course, the inclined as well as the horizontal cornice, with the grand deeply under-cut Augustan moldings thereto belonging. This piece will naturally determine the exact dimensions, and give us a precise picture of the great pediment of this Octo-style peripteral temple, as rebuilt, A. D. 6, by Tiberius and Drusus from the spoils taken from the Teutons. The foundations of the temple itself, at its southwest angle, to the Vicus Tuscus, or Tuscan Street, are now completely explored and laid bare.

In looking at this fragment, thus miserably fallen from its lofty position into the condition of stopping a drain, one could not help recalling a pretty story strangely overlooked by the compilers of popular archæological works, relating to this temple in its pristine beauty. Pliny tells it, to the effect that a young jackdaw, whose parents had a nest in the temple, came into the possession of a cobbler whose shop was in the neighboring street. He seems to have educated the bird most effectually; for it not only learned a little rhetoric, but it used in time to fly of a morning across to the rostra of Julius Cæsar, near the arch set up by Tiberius in honor of the recovery of the eagles lost by Varus, and thence it would chatter away to the passers-by in the Forum. One can easily imagine how pleasantly the people of those days regarded the knowing bird. It speedily became a favorite, and, what is more, brought custom to its owner. But after performing in this manner for a considerable time, a rival shopkeeper, declaring that the bird had soiled some of his wares, killed it; either, says Pliny, "in a sudden fit of anger, or from sheer envy." The slayer seems to have been driven out with violence by an exasperated mob, and we may believe he did not escape with his life. The dead bird, however, was actually honored by a public funeral. Laid out on a bier, it was carried by two Ethiopians (I suppose as being a blackbird, and thus related to the Gods below, whose victims were always black) as far as the second milestone on the Via Appia "in campo Rediculi appellato," and there buried.

Rome abounds with these birds, and it is not an uninteresting time of year to observe their habits from a city roof at sundown. They are seen returning every evening from their feeding grounds on the green Campagna, and they settle on the gilded crosses and bell towers of the city until "Ave Maria" sounds; sometimes literally blackening them. The moment the bells cease their clanging the birds drop down into their cozy crevices for the night. One never counts a flight, however numerous, composed of uneven numbers, at this season. The Church of Trinità de' Monti seems to house eight; that of St. Andrea delle Fratte houses twelve of them; and all interloping, or blundering, couples are driven off.—Public Opinion.

Steamship Facilities Between the United States and the Levant.—In continuation of my report on this subject of December 27, 1901,* I would state that Beirut and the Syrian coast are not at present included in the itinerary of the new American-Levant Line, and Egypt will be touched only by outgoing steamers. In order to reach Syria and Palestine by this route, American goods must be transshipped at Alexandria.

* Advance Sheets No. 1259 (February 7, 1902).

Freight and passengers from Syria to the United States may be transshipped at Malta.

I have urged the companies interested to cover the whole field from the start, but they say it is not possible for them to do so. It will be necessary for that purpose, they state, to establish two routes, viz.: (1) New York, Piræus, and Odessa; (2) New York, Malta, Alexandria, Beirut, Smyrna, and Constantinople.

Already, the northern route has been inaugurated. Next year, if the exports from the United States attain the expected dimensions, the second route will be realized.

Further particulars may be obtained by consulting the Hamburg-American Line, 35 and 37 Broadway, New York city.—G. Bie Ravndal, Consul at Beirut.

LAMPS, BURNERS AND HEATING APPARATUS AT THE PARIS ALCOHOL EXPOSITION.

THE lighting apparatus shown at the Competition and Exposition of Alcohol Apparatus organized by the Minister of Agriculture of France may be divided into two classes as follows:

1. *Incandescent Apparatus.*—Lamps of great power, and lamps for domestic purposes.
2. *Apparatus with Exposed Flame.*

The incandescent apparatus in which either denatured (adulterated) or carbureted alcohol was used, was undeniably the most important and interesting because of the great number of different styles and systems that figured therein. Experiments made by specialists in recent years have shown that great benefit may be derived from the combustion of alcohol in a vaporous state combined with the use of an Auer mantle rendered incandescent by a Bunsen burner.

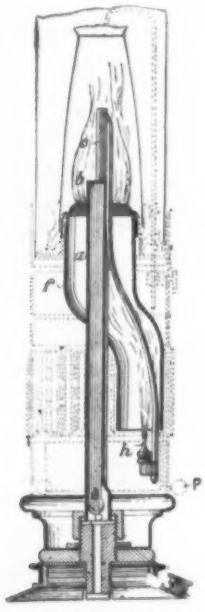


FIG. 1.—LA CONTINENTALE NOUVELLE COMPANY'S "1900" BURNER.

In an incandescent alcohol lamp, whether it be stationary or portable, it is necessary to vaporize the alcohol previous to combustion, and it is precisely the manner of effecting such vaporization that has been the object of the researches of manufacturers. Some have adopted the use of a small lighter placed in the interior of the burner and heating a plate of metal, and others have obtained the vaporization from the heat of the incandescent burner transmitted through a metal rod to the vaporizing chamber.

In the first class mentioned above, the lamps, the luminous intensity of which is capable of reaching 634 candle power per burner, all utilize alcohol under pressure, vaporized and mixed with air. La Continentale Nouvelle Company exhibited a lamp provided with the "1900 burner." This lamp (Fig. 1) operates under a pressure of about 1 pound per square inch obtained either in the alcohol reservoir itself by having a column open to the pressure of the atmosphere put under pressure at the moment of lighting; or, as is done in automatic lamps, by a rubber bulb, which is squeezed three or four times in order to compress the air contained in the reservoir; or, finally, by means of an independent air reservoir and a pipe to lead the compressed air to the reservoir of the lamp.

The alcohol rises in the tube, *a*, which contains a small metal dividing brush, *s*, and is vaporized in the part, *b*, of the burner forming a boiler. The vapor reaches a high pressure in the superheater, *c*, and then descends through the small tube on the right to the nozzle, *h*, through which it makes its exit at a calculated pressure that permits it to carry along some of the air contained in the mixer, *f*. The gas thus produced passes through the wire gauze and burns above in the form of a blue flame, which when covered with an incandescent mantle, produces a beautiful light. A small fork provided with two balls of asbestos is previously dipped in the alcohol and placed in the conduit of the burner through a small door situated at the lower part and opened by means of the ball, *P*. Fire is communicated to the fork by means of any sort of flame, and, 30 seconds afterward, when the fork is observed to be on the point of becoming extinguished, it suffices to remove it and place it over the burner, at the same time squeezing the rubber bulb connected to an air cock fixed to the apparatus. Ninety-degree denatured alcohol is the kind used in this lamp.

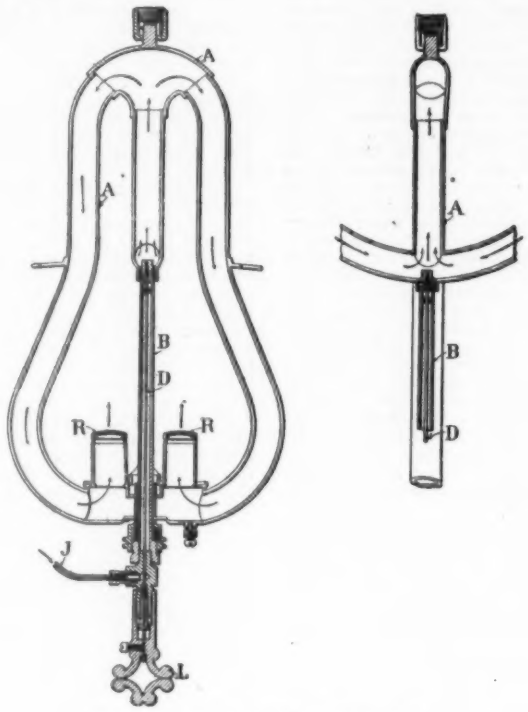
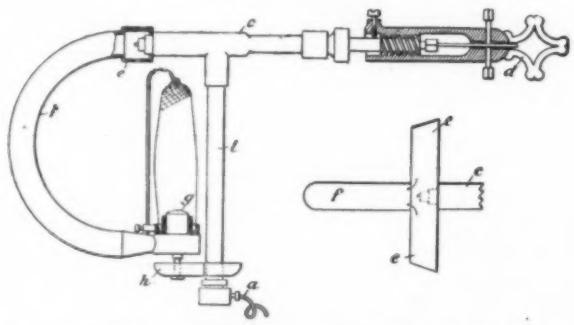


FIG. 3.—"WASHINGTON" LAMP.

A. Body of the lamp. B. Vaporizer. D. Regulating valve. J. Oil inlet. L. Valve key. R. Burners.



FIGS. 4 and 5.—THE KORNFELD "RUSSIAN IMPERIAL" LAMP.

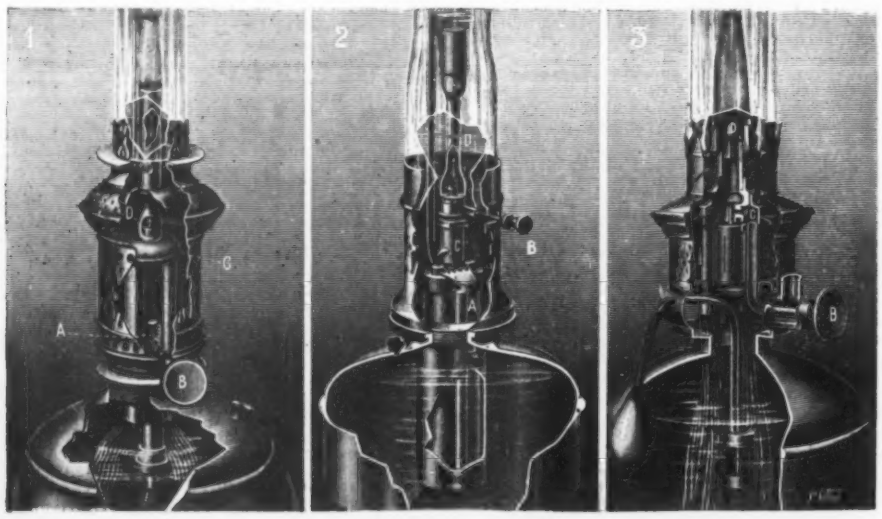


FIG. 2.—ALCOHOL LAMPS.

1. "Préféré" burner. 2. Denayrouse burner. 3. "Helios" burner. A. Lighters. B. Regulating keys. C. Vaporizers. D. Bunsen burner.

The Société d'Eclairage, de Chauffage et de Force Motrice (Denayrouse system) exhibited its apparatus (Fig. 2, No. 2) in a salon in which the variety of the arrangements attracted the attention of visitors. Moreover, a lamp completely dismounted permitted of studying the system and judging of its construction. For the ignition there is arranged a small lighter surmounted by a silver plate designed to direct the flame to the upper part of cellular tubes (two or more in number according to the power of the lamp). The vapor of the alcohol flows to a Bunsen burner, at the base of which a regulating cone operated by button, *B*, permits of causing the quantity of alcohol vaporized, and consequently the intensity of the mantle, to vary at will. Above the latter, a copper disk supported by a rod at the side serves for heating by conductivity the upper part of the cellular tubes, after extinction of the lighter.

The lamps of the Société la Washington are of two kinds: (1) The "Washington" lamp proper (Fig. 3), which has two or three burners and utilizes 50 per cent carbureted alcohol. (2) The Kornfeld "Russian Imperial" lamp (Figs. 4 and 5; also Fig. 6, No. 2), in which pure alcohol, carbureted alcohol or kerosene may be used at will.

This lamp, the economic results of which are very remarkable, gives, with a single burner, a luminous intensity of 634 candle power and consumes but 0.11 fluid drachm of 50 per cent carbureted alcohol per candle power hour. It operates at a mean pressure of 28 pounds to the square inch.

The installation of this system of lighting comprises, in the first place, an independent reservoir, the capacity of which must be sufficient to permit of the operation of the lamp for 15 hours without the necessity of paying any attention to it. A 12 or 13 gallon reservoir is of sufficient size for this. The quantity of air necessary to obtain a pressure of 42.6 pounds to the square inch is introduced by means of a bicycle pump. Such pressure at the end of 15 hours falls to 28.4 pounds, without any variation in the light, provided the lamp has been well regulated at the outset.

The alcohol is afterward conveyed to the lamps, which may be as far as 500 feet away, through a relatively thick brass tube, the internal diameter of which varies from 0.157 of an inch at the start to 0.078 of an inch at the junction with the lamp. No gas or vapor circulates in the conduit, which carries cold liquid only.

The lamp itself is provided at its lower part with

a cock, *a* (Figs. 4 and 5), into the shell of which the alcohol flows, and afterward ascends under the influence of pressure in the tube, *b*, which is heated by the radiation of the incandescent mantle. The alcohol becomes vaporized and enters the body of the regulator, *c*, which consists of a needle valve that is turned by means of the key, *d*, and that opens a very small aperture through which the alcohol vapor escapes. At the same time there is produced laterally a draft of air that may be regulated by increasing or reducing the apertures, *e* (Fig. 4) according to whether denatured or carbureted alcohol, or kerosene is employed. The vapor of the alcohol mixes intimately with the air while traversing the curved tube, *f*, whence it flows to the burner and burns at the surface of a wire gauze screen. This apparatus, like all others of the kind, requires a preliminary heating, which is accomplished by burning alcohol in a cup, *h*, arranged at the base of the burner.

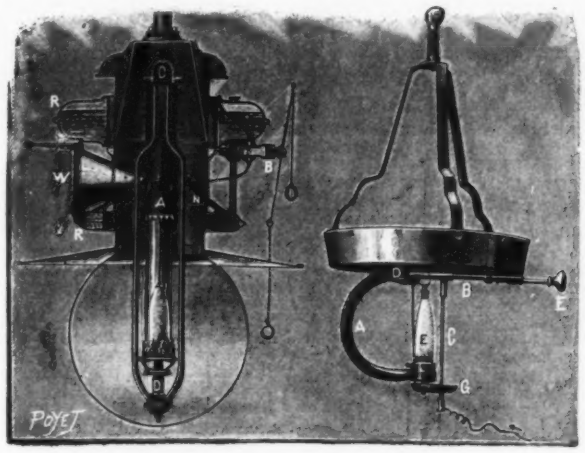


FIG. 6.—ALCOHOL LAMPS.

1. "Monopole" lamp. 2. "Washington lamp. A. Vaporizers. B. Regulating valves. E. Mantle. R. Alcohol reservoirs. W. Ignition orifice.

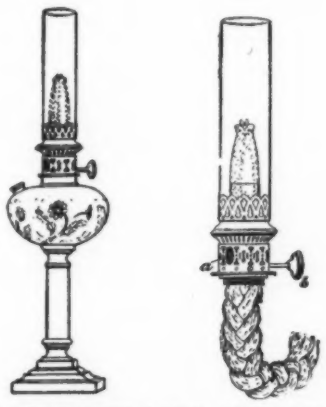


FIG. 7.—DECAMPS' LAMP AND BURNER.

This lamp, which has already been tried with success by the Compagnie du Chemin de Fer du Nord, especially during the fêtes attending the reception of the Czar at Dunkerque, where kerosene was used as the fuel, operates now equally well with alcohol, and may be employed in cases in which the use of an electric arc lamp would be much more costly. The Washington lamp with two burners seems to give with denatured alcohol results that are interesting, but less advantageous than those given by the Kornfeld lamp, which requires only a mantle and is more economical.

The Hautz lamp, in which vaporized kerosene was formerly used with an incandescent mantle, has been improved and fitted for operating with denatured alcohol. It furnishes a luminous intensity of about 73.6 candle power for 7 hours with a total consumption of 1.76 pints of alcohol, or 119.6 candle power for 5 hours with the same consumption. This corresponds to about 0.45 to 0.49 fluid drachm of alcohol per candle power hour. From 14 to 28 pounds air pressure is used in the reservoir. The incandescence is very satisfactory and the light very steady.

Lamps for Domestic Purposes.—The general principle of the operation of these lamps consists in the introduction of alcohol into a vaporizer (1) by the capillarity of the wicks, (2) by the pressure of air, or (3) by hydrostatic pressure. The vaporizer is heated, either by a small lamp or by the conduction of the heat developed in the burner.

Messrs. Decamps & Co. presented a lamp (Fig. 7) in which the alcohol is led to the burner by a wick. The heat for vaporization is obtained by conduction. The vapor escapes through a conical nozzle and flows to the burner where it is ignited in contact with the mantle. The system is so combined that extinction is instantaneous and gives rise to no disagreeable odor. It is effected by turning a thumb wheel, *b*, as in ordinary lamps. The burner has been so arranged that it can be substituted for the ordinary kerosene ones, the height of the luminous point, as well as the pitch of the screw, being exactly the same as in the lamps of from 12 to 22 lines.

This type of lamp seems to be very practical. The light is very steady, and the reservoir does not become heated. There was but one model of the lamp shown at the Exposition. This had an illuminating power of 55 candles and consumed 1.76 pints of ordinary denatured alcohol in 10 hours, say 0.52 fluid drachm per candle power hour. La Continentale Nouvelle Company presented also for domestic uses a lamp called "Bec Préfére." While the "1900" lamp of this establishment necessitates a burner of considerable height, which removes the luminous part to some distance from the reservoir, the "Préfére" has been devised with a view to having a burner similar in size to a kerosene one and capable of being substituted for the latter on the same lamp.

This apparatus comprises a feed wick, *h* (Fig. 8), which introduces alcohol into the chamber, *a*, in which the vaporization occurs. The alcohol vapor makes its exit through the injector, *b*, and flows to the burner, at the same time producing a draft of air. The heat necessary for the vaporization of the alcohol is obtained by means of a small lamp, the flame of which is protected against currents of air by the metal part, *c*. The wick of this little lamp is surrounded by a tube, *d*, provided with a rack by means of which it can be raised or lowered according to the size of the flame that it is desired to have. This ingenious arrangement permits of a rapid extinction of the lamp, and, at the same time, prevents the evaporation of the alcohol after extinction, if care be taken to raise the tube, *d*, until it touches the bottom of the vaporizing chamber, *a*. This tube is raised or lowered by means of the thumb wheel seen at the side of the burner. In order to light the burner, the small lamp is employed. The tube is lowered to the bottom and the wick ignited, and at the end of a minute the burner may be lighted by holding a match over the top of the glass chimney,

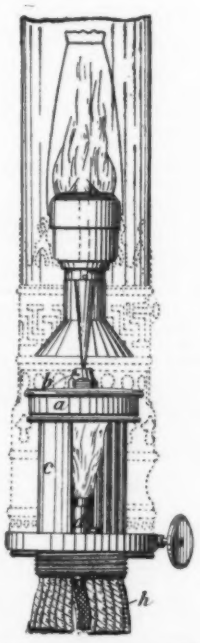


FIG. 8.—LA CONTINENTALE NOUVELLE CO.'S "PRÉFÉRÉ" BURNER.

FIG. 9.—"REGINA" BURNER.

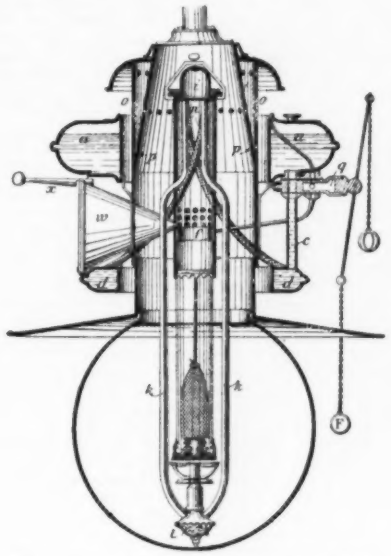


FIG. 10.—THE DELAMOTTE LAMP.

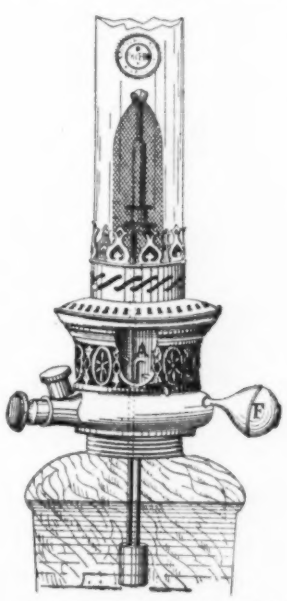


FIG. 11.—THE "HELIOS" BURNER.

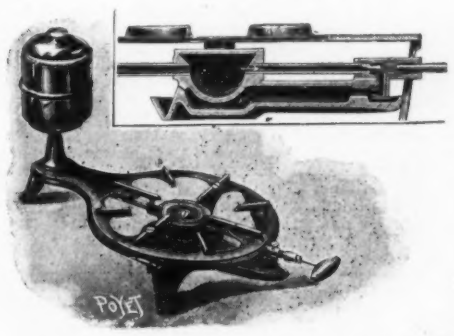


FIG. 12.—"LA REGLABLE" GAS STOVE.

(Section of the vaporizing burner in the corner.)

The regulation is effected by means of the key that actuates the movable tube, which should be so placed as to give a flame about one-quarter inch in height. The replacing of the mantles is done in a very practical manner, through a peculiar mounting that permits of substituting one socket for another without the necessity of hooking the mantle to its support. Moreover, the mantles are made small in diameter and elongated in form, which renders them less fragile.

This lamp utilizes ordinary alcohol. Its luminous intensity is 55 candle power for a consumption of 1.76 pints of alcohol in 8 hours, or 32 candle power for the same consumption in 15 hours, say from 0.55 to 0.59 fluid drachm per candle power hour. A good idea of this lamp will be had from Fig. 2, No. 1.

The principle of the "Regina" burner (Fig. 9) is the same as that just described.

This burner consumes 1.76 pints of ordinary denatured alcohol in 10 hours and gives a luminous intensity of 46 candle power, which corresponds to a consumption of 0.58 fluid drachm per candle power hour. The lamp may be turned up or down at will, by increasing or diminishing the flame of the small lamp that heats the vaporizing chamber.

A lamp, the construction of which differs sensibly from that of the preceding, is M. Delamotte's. It is not new, however, since it is merely a form of the "Monopole" lamp (Fig. 6, No. 1) which is itself but a modification of the Schuchardt lamp that has been used in Germany for nearly two years. But, since it is not as yet well known in other countries, it will perhaps be well to give a description of it.

In this lamp (Fig. 10) the alcohol contained in an upper reservoir, *a*, descends through the tube, *c*, into the reservoir, *d*. Into this latter, in which the fluid is submitted to a hydrostatic pressure, enter the extremities of tubes, *n*, provided with asbestos wicks which introduce the liquid into the gasifier, *i*, in which the vaporization is produced under the influence of the heat of the mantle. The vapor thus formed passes into the tubes, *k*, and thence into the asbestos receptacle, *l*, in which are deposited the drops due to condensation. It then mixes with the air drawn in through the apertures in the sides and burns beneath the mantle.

The object of the lower reservoir, *d*, is to render the flame regular by automatically regulating the entrance of the alcohol into the conductors, *n*. The hydrostatic pressure is, moreover, constantly balanced by the pressure of the alcohol vapor. A cock, *q*, permits of putting the two reservoirs in communication and allowing a small quantity of alcohol to pass into the annular cup, *f*.

The lamp is started through the funnel, *w*, by lifting the cover, *x*, and igniting the alcohol that has been admitted to the cup, *f*, by pulling the chain, *o*, that serves to open the cock, *q*. After the alcohol has been ignited, the cover, *x*, is closed and the liquid allowed to burn. At the end of half a minute gas is produced, and, escaping from the burner, is lighted by the alcohol flame above. This lamp consumes 4.22 fluid ounces of ordinary denatured alcohol and produces about 73.6 candle power, which corresponds to a consumption of 0.55 fluid drachm per candle power hour.

The Compagnie Générale de l'Alcool exhibited some lamps provided with the "Helios" burner, which in reality is the "Phœbus" burner. (Fig. 11 and Fig. 2, No. 3.) The alcohol ascends to the burner under the effect of a slight pressure exerted by a rubber bulb, *F*, and follows a double conduit formed of two wicks, *A*. It is at this point that the lamp is first lighted. At the end of a minute, the alcohol is vaporized and the igniting wick becomes extinguished, while the mantle is incandescent and the vaporization continues through the conduction of the heat disengaged by the central rod. This lamp can be filled without unscrewing the top, as the orifice situated below the extinguishing key permits of filling it even while it is in operation.

The 11-line type of lamp gives an intensity of 41.4 candle power with a consumption of 1.76 pints of alcohol in 10 hours, or 0.64 fluid drachm of ordinary denatured alcohol per candle power hour.

Among the free flame apparatus in which carbureted alcohol is used may be mentioned in the front rank that of the Société Française de l'Alkolumine, the interior lamp of which utilizes a special 35 per cent carbureted alcohol. This lamp has a wick and chimney analogous to those of kerosene lamps.

Heating Apparatus.—It results from the experiments made by the jury that a quart of pure alcohol is, for heating, sensibly equivalent to 35 cubic feet of illuminating gas. Consequently, in order that a contest may be possible, alcohol must be sold for domestic purposes at a price not exceeding six cents a quart.

The apparatus that were most remarked by the jury of awards were the following:

The Société la Continentale Nouvelle and MM. Descamps & Co. respectively exhibited a stove with visible fire and a stove with wicks operating with pure alcohol, and the general principle of which is analogous to that described for lighting apparatus.

The Société des Fourneaux-Calorifics Polo is constructing stoves in which the vaporization is effected by a lighter upon the wick that leads the alcohol. The combustion takes place in a ring supplied by a Bunsen burner, and the upper part of the wick that serves for ignition is put out by a small extinguisher operated by hand.

MM. Fouilland & Co. exhibited stoves with several openings for domestic use, dish warmers, and brazing and soldering lamps supplied under pressure either by an independent reservoir or by a reservoir forming an integral part of the lamp. In these apparatus, the recuperation is assured by special metal mantles. M. Barbier exhibited an ingenious stove (Fig. 12) made entirely of cast iron and seemingly very practical for domestic purposes. He calls it very properly "Le Réglable."

As regards household apparatus, it is well to mention the smoothing irons of MM. Winterberger, the various apparatus employing solidified alcohol, and "La Merveilleuse" foot-warmer.

The German manufacturers were very brilliantly represented at the Exposition by the Crown Distillery and the General Alcohol Company, which exhibited apparatus of all kinds operating with pure, carbureted or solidified alcohol. All these apparatus, kitchen ranges, stoves, furnaces, chafing dishes, smoothing irons and industrial devices, formed a very complete and interesting *ensemble*.

Aside from the special heating and lighting apparatus of which we have just spoken, it is well to mention the system presented by M. Brangier in the name of the alcoholene syndicate. This apparatus consists of a genuine gas generator that produces carbureted air by means of a special etherified alcohol. The producing apparatus consists of casks filled with a very absorbent porous material impregnated with alcoholene. Through a very simple device, air is made to pass through this at the desired pressure, and there is thus formed a gas that may be used for supplying simple, Auer or Bunsen burners, gas stoves, bath heaters, etc.—For the above particulars and the engravings, we are indebted to La Nature and Le Genie Civil.

PHYSICAL AND CHEMICAL PROPERTIES OF ALCOHOL AND PETROLEUM.

THE most important alcohols from an economic point of view are:

Ordinary or ethylic alcohol (CH_3O) which boils at 78.4 deg., has a density of 0.8026 at 0 deg. and a calorific power of 7,080 calories per kilogramme.

Methylic alcohol ($C_5H_{12}O$), a liquid with a very disagreeable odor, boiling at 132 deg. and obtained from the rectification of alcohols derived from beet roots, grape-skins, and potatoes. Its density is 0.825 at 15 deg. C. and its calorific power 9,022 calories per kilogramme.

Denatured alcohol, of the Regie type, which is used for lighting and heating under the title of ordinary alcohol, is composed of ethylic alcohol (100 liters), methylic alcohol (10 liters), and heavy benzine (500 centiliters, 0.5 kilogramme). Methylic alcohol generally contains about 25 per cent of acetone, which is the true adulterating or denaturing substance, and 5 per cent or less of hydrogenated impurities.

As for the benzine employed, its density is 0.880 at 15 deg. C. and its calorific power 8,460 calories per kilogramme.

The denatured alcohol thus obtained boils at 77.5 deg. C., has a density of 0.832 at 15 deg. C., and its calorific power, measured by the calorimetric bomb of M. Mahler, is about 5,900 calories.

The annexed table permits the comparison of the calorific powers of the most important alcohols in both a gaseous* and liquid state, and of denatured alcohols, and some of the other liquid combustibles in their natural liquid form.

Finally, it should be added that the inflammation point of pure alcohol is 18 deg., while that of kerosene is 40 deg. and that of gasoline 17 deg. C.

Carbureted alcohol, such as is used in open flame burners and sometimes in those with an incandescent mantle, is derived from denatured and not from pure alcohol. The carburetion consists in the addition of benzine, naphthaline, etc.—in general, of liquids rich in carbon; but the benzine employed is richer than that used in the Regie mixture. The most practical proportions appear to be 50 per cent of denatured alcohol and 50 per cent of hydrocarbons, or 75 per cent of the former and 25 per cent of the latter.

The German *Leuchtspiritus* contains 35 per cent by volume of a mixture of aromatic hydrocarbons boiling at from 80 deg. C. to 180 deg. C., together with a more or less definite quantity of naphthaline.

Combustible.		Density at 15° C.	Calorific Power.*
Ethylic alcohol	in liquid state	0.8026 (at 0° C.)	7,080
	in gaseous state	0.8026 (at 0° C.)	7,202
Methylic alcohol	in liquid state	0.798	5,534
	in gaseous state	0.798	5,600
Amylic alcohol	in liquid state	0.825 (at 0° C.)	9,022
	in gaseous state	0.825 (at 0° C.)	9,143
Denatured alcohol (Moto-Schnick)		0.833	5,906
50% Carbureted alcohol (Electrine)		0.840	7,078
Gasoline, French (Stelline)		0.680	11,025
Gasoline, American		0.680	11,086
Kerosene, French		0.800	10,344
Kerosene, American refined		0.800	11,047
Heavy oil of petroleum, American		0.800	10,913
Heavy oil of Baku, Russia			10,805
Heavy oil of Paris Gas Works		0.800	8,880

*The calorific powers are indicated at constant volume and per kilogramme.

If kerosene is compared with alcohol, a great difference will be noted in their calorific powers, since, practically, the quantity of heat furnished by a liter of kerosene is about equal to that in 1¼ liters of alcohol. This is not the case, however, if the alcohol is carbureted, for it then has a greater calorific power than the pure alcohol, while the price diminishes as the proportion of pure alcohol in the mixture decreases.

As far as lighting is concerned, it has, we believe, been conclusively shown from the model lamps exhibited in the Grand Palais, that alcohol must fall to a price of $0.028 per pint in order to enter into serious competition with kerosene. But outside of the economic question, alcohol has certain advantages over kerosene, for it has none of the greasy and odoriferous qualities of the latter, while it furnishes a very agreeable light. As soon as the economic problem has been solved, either pure or carbureted alcohol can be used commercially in lighting apparatus.

It has often been stated that alcohol is more economical than kerosene for lighting purposes. This is only true when the alcohol lamps using an incandescent mantle are compared with the kerosene wick lamps. Kerosene lamps with an incandescent mantle, while not being actually employed for domestic use, have been used successfully for lighting large rooms, where an intense light is desired.

* We give the calorific powers in a gaseous state because of their importance in explosive motors. These determinations were made by M. Berthelot.

INVESTIGATION OF CERTAIN CHEMICAL REACTIONS DETERMINED BY RADIUM.*

As is known, remarkable effects are determined by the special radiations of radium.

This is a new field, opened to science by M. Curie, a field connected with the discoveries of M. Becquerel. M. Curie has had the courtesy to furnish me with a sample of his precious products, and I have experimented for the purpose of comparing certain specific chemical reactions determined by light and the electric effluvium, with those which radium is capable of producing. Such experiments are troublesome, by reason of the very small quantities of radium chloride made use of (about 0.1 gramme in the present case) and of the necessity of operating through coverings of glass, which absorb a part, perhaps sometimes the most effective, of the radiations, and finally by reason of the duration required in the production of the phenomena.

The product received from M. Curie was contained in a small glass tube sealed by lamp. To obtain more precise results I decided to place the small tube in a concentric tube, quite thin and nearly tangent to the other. These were, according to the cases, inserted in a test tube in the midst of liquid or pulverulent matters which I proposed to influence through the double thickness of glass; or, simply juxtaposed in a tube of this kind, forming three thicknesses of glass. I would have preferred to operate more directly, but I feared complicating the chemical phenomena. My investigations were conducted in a completely dark inclosure. At the distance of a few centimeters I placed in each case a similar arrangement of tubes containing the same impressionable substance, but without radium, in order to serve for comparison.

I. Iodic Acid.—This in powder was acted on by the radium in the central tube at the temperature of about 23 deg. At the end of three days it was not modified appreciably. At the end of nine days it began to show a violet tint. At the end of two weeks the iodine vapor was much more apparent, and its proportion increased slowly during the following two weeks. The comparison tube remained perfectly white.

According to my experiments in 1898 light decomposes iodic acid into iodine and oxygen. Radium produces the same effect in darkness. I selected this reaction designedly as endothermic:

I_2O_5 solid $= I_2 + O_5$ absorbs I_2 solid .. —48.0
I_2O_5 solid $= I_2 + O_5$ absorbs I_2 gaseous —61.6

The inquiry may arise whether the radiations which produced these effects had a different character from those emitted by the compound of radium viewed as a body rendered simply phosphorescent by its own energy, and thereby become luminous in darkness; which would be equivalent to the insertion of an intermediate mechanism, the total reaction remaining attributable to the influence of the radium. The continuous renewing of the reaction during quite a prolonged interval of darkness would accord with these interpretations. It might still be true that the active radiations did not arise from such phosphorescence. The question is interesting, and I hope to be able to consider it shortly. In either case there is an incontestable storing of energy due to the presence of radium.

II. Monohydrated Nitric Acid.—I employed a sample prepared and completely inclosed in a sealed tube three years ago, at the time of my researches on the action of light. This had been preserved in absolute darkness and had remained perfectly colorless.

According to my former experiments the action of light is not instantaneous. It is sufficient to expose a tube of this kind to the light of the sun for two hours, to color it strongly yellow, with disengagement of nitrous vapor and free oxygen.

I placed the tube of nitric acid next the tube of radium, operating, of course, in darkness. At the end of two days the latter had commenced to yellow, and this action was intensified during the following three days. This reaction, which is endothermic, is common to the light and to radium.

III. There are two reactions which light is susceptible of producing and which have not taken place in my experiments with radium.

It is known that a solution of octahedral sulphur in carbon sulphide exposed to light soon deposits insoluble sulphur by virtue of an exothermic reaction. With the radium tube immersed in the solution in darkness there was no effect, at least in twenty-four hours.

IV. Gaseous acetylene is very sensitive to the action of the electric effluvium, giving rise to an exothermic polymerization. On the contrary, it appears insensible to the action of ordinary solar light at the ambient temperature. This gas has not been modified in the course of several days by the radium contained in the sealed tube.

V. It is well known that light determines the slow oxidation of oxalic acid dissolved by free oxygen, an exothermic reaction:

$C_2H_2O_4$ solid $+ O = 2\,CO_2H_2O$ liquid... ..... + 60.0 cal.
$C_2H_2O_4$ dissolved $+ O = 2\,CO_2$ dissolved $+ H_2O_2$ liquid .. + 689 cal.

Light here plays the role of a determinant without furnishing the energy consumed.

I took a titrated solution $C_2H_2O_4 = 20$ liters.

1. Two c.c., measured exactly, were submitted in darkness to the action of radium within a test tube containing air.

2. Two c.c. were kept in such a tube some decimeters distant in darkness.

3. Two c.c. were kept in such a tube in diffused light on the table of my workroom.

4. The same solution (75 c.c.) in a well-stoppered flask almost completely filled, that is, not containing, so to say, free oxygen, remained on the same table in diffuse light.

Two months and a half later I titrated these liquors carefully, operating for the first three in the same tubes without any effusion. At the outset the proportion amounted to exactly 40 parts of pure alkali. At the end, the percentages were: First, 40 parts; second,

* From the French of M. Berthelot. Memoir presented to the Académie des Sciences.

40 parts; third, 36 parts; fourth, 40 parts; 2 c.c. had been previously taken out.

According to these results, the oxygen of the air had exercised no action on oxalic acid in darkness, even when these bodies were submitted to the action of radium. On the contrary, the oxygen had oxidized oxalic acid under the influence of diffuse light; the light employed alone leaving unchanged the oxalic acid removed from the action of oxygen under the conditions of my experiments.

It is possible that this apparent inactivity is attributable to some absorption occasioned by the double and triple thickness of glass which separated the radium from the bodies exposed, the more penetrating radiations alone being transmitted. The radiations of radium are probably multiple, like those of light, and the ones that determine certain actions may be arrested by a body which is transparent from radiations endowed with a different activity. It is proper to speak with some reserve on this point, especially in view of the facts to be related hereafter concerning the change in the glass.

However this may be, it is seen that the whole action caused by the light or by the electric effluvium, if endothermic, is not susceptible of being developed by the radiations of radium acting through glass. Still, I have shown that these determine certain reactions, even endothermic, that is, accompanied with a consumption of energy, such as the decomposition of nitric acid and that of iodic acid.

The radiations of radium in the two reactions observed have the same efficiency as those of the solar light.

VI. Special mention should be made as to the influence which radium appears to exercise at the same time in two opposite directions. This influence is exercised on glass. The thin tube separating the sealed thin radium tube from the substances operated on, the solution of oxalic acid, for instance, did not remain intact; that is, altogether transparent. It was blackened, conformably to the observation made by other persons. This appears due to the reduction to the metallic state of the lead contained in the glass; a reaction which may be either endothermic or exothermic, according to the mode of decomposition of the complex materials of which the glass is composed. At the same time I have observed a fact, not mentioned before, I believe; the violet coloration of a portion of the glass contiguous to the blackened regions. This coloration of ordinary glass explains in general the formation of an oxygenated compound of manganese. The formation of this compound would be exothermic, if it took place at the expense of the oxygen of the air, as happens in the case of certain kinds of glass which become violet under the influence of the light. But the present case is more complex, the superoxidation of the manganese being complementary to the reduction of the lead.

There appears, therefore, to be a double phenomenon, accomplished simultaneously under the influence of the radiations of radium; the reduction of the lead, endothermic, and the superoxidation of the manganese, exothermic. These two phenomena may result from the concurrent actions of two kinds of radiations, unless it should be supposed that there is a veritable electrolysis, an ionization, effected within the glass, under the influence of the radiations of the radium and of the secondary actions accompanying this electrolysis.

In any case the present observations show that it is doubtful whether a portion of the radiations of the radium are absorbed by the glass. It would be necessary to operate in the open light, if it could be done without causing the radium itself or its compounds from intervening chemically in the reactions. In a more general way these observations suggest quite a series of methodical experiments for comparing the actions of the light, those of the electric effluvium and those of the radium, both as determinants of chemical transformations and as sources of the energy consumed in these transformations.

SECOND MEMOIR.

I have continued the chemical experiments undertaken with the sample of radium furnished to me by M. Curie and have taken up the consideration of the decomposition of iodic anhydride as pure as possible, on account of the endothermic character of this decomposition. I have investigated two points, namely, the role of phosphorescence and the relative extent of the energies put in action by the intervention of this new element. My experiments have taken place in an inclosure protected from the entrance of the external light as far as possible.

I operated at a temperature of about 10 deg. and a temperature of 100 deg., always under a pressure very near the atmospheric pressure, prolonging the exposure for a period more or less extended. Each time these comparative tests were made with iodic acid under conditions and with arrangements as much alike as possible, namely, an experiment in blank, an experiment in presence of a tube containing radium capable of acting by its phosphorescence, and an experiment in presence of the same tube surrounded with black paper, in order to intercept every influence attributable to the interior light of the inclosure resulting from the phosphorescence.

I employed a weight of active matter equal to 0.145 gramme containing, according to M. Curie, an eighth of his weight of radium chloride, or a little less than two centigrammes, the surplus being barium chloride. The matter was inclosed in a very small sealed glass tube; lead glass in the first series; glass without lead in the second. This tube was inserted in a thin tube a little larger, which was surrounded with iodic anhydride (4 or 5 grammes).

The three tubes, arranged horizontally, were placed in a dark inclosure, where no light could penetrate. Through the enveloping tube circulated slowly a current of air perfectly dry, which escaped by the tapering part of the tube into two bubbling tubes containing: one, 20 cubic centimeters of a thousandth part solution of silver nitrate, the other an equal volume of a dilute solution of pure potash.

I. In the first experiments, made at the ordinary temperature, the air passed through the apparatus at the rate of 0.6 liter or 0.7 liter per hour, a circulation sufficiently slow to assure the absorption of the vapors of iodine and of iodic acid. The experiment was continued for seven days. This time was necessary, according to my preceding experiments, in order that the iodic anhydride should present quite visible signs of decomposition.

In fact, in two experiments, one made in blank, that is to say, without radium, the other with a radium tube surrounded with black paper, the iodic anhydride treated, compared with the initial sample, had not been colored, that is, decomposed. The tube of silver nitrate furnished no visible precipitate.

On the other hand, the potash of the bubbling tube had been collected and acidulated with dilute nitric acid; nitrate of silver had been added to it from the other bubbling tube, then a small quantity of dissolved sulphurous acid had been mixed with the whole in such a way as to reduce the iodic acid, if there was any in the liquors, and to precipitate the iodine in the form of silver iodide; this did not occur.

On the contrary, the third experiment, made with a radium tube not surrounded with black paper, exhibited a slight but distinct violet tint of iodic anhydride; a result conforming to that of my previous experiments, but more precise, if it could be. Meanwhile the iodine, thus disseminated and existing within the iodic anhydride, had not been drawn off in the successive liquors (silver nitrate and potash) in sufficient proportion to furnish a ponderable precipitate of silver iodide. The precipitate was, however, quite visible at the bottom of the vessels.

The radium tube had not varied by a third of a milligramme in the course of the preceding experiments. But it had blackened in the accustomed way of lead glass.

An essential fact is ascertained by these observations, that the decomposition of iodic anhydride becomes manifest only under the influence of the radium exercised without the intervention of the black paper, that is, in the conditions in which the phosphorescence of the mixture is manifested. The radiations which produced this phosphorescence, in consequence of a double conversion of energy, had acted in this experiment a characteristic part.

II. Three of the comparative experiments, directed in the same way, were executed at 100 deg., within an inclosure kept at a constant temperature by a current of steam. The matter was poured from the tube which contained it into another similar tube, but free from lead, then closed by the lamp; the decanting occupied but a few seconds. I had verified the fact that it preserved its phosphorescence at 10 deg., and the same at the temperature of 100 deg.

If I thought it useful to operate at 100 deg. it was not with the intention of increasing the radio-activity, which, according to M. Becquerel, does not change between —200 deg. and 100 deg., but with the idea that the iodic anhydride would perhaps become more changeable on raising the temperature, the quickness of reactions increasing in general, according to my researches, as an exponential function of the temperature. Thus, for example, the speed of etherification becomes 425 times greater in passing from 8 deg. to 100 deg.

I have kept iodic anhydride in presence of radio-active matter at 100 deg. for three hours, the current of air designed to draw off the volatile products being nearly twice as rapid as in the experiments made at about 10 deg.

Under these conditions the iodic anhydride experiences a visible sublimation, but extremely slight; for the final precipitate of silver iodide is not ponderable. The iodic anhydride remains colorless at the end of the experiment; as well in the hot tube contained in the inclosure, as in its cooled tapering exterior (in which the almost imponderable visible traces of crystals are condensed) and in the traces of pure white precipitate formed directly in the silver nitrate. It seems, therefore, that the iodic anhydride has not experienced appreciable decomposition, even by its change of tint.

Between the duration of this experiment and that made at about 10 deg. the ratio is $\frac{168}{3} = 56$. This figure, compared with the number 425 mentioned above, shows that the variation in the decomposition of iodic acid occasioned by an elevation of temperature, if it exists, would be incomparably less than for etherification, a contrast as much more marked as etherification is a reversible reaction, that is, retarded by the reverse reaction, while, according to known facts, the decomposition of iodic anhydride by radium does not appear reversible.

The experiment made at 100 deg. has allowed of comparing another class of phenomena. The six hours of reaction occurring on the tube of glass free from lead containing the radio-active mixture was sufficient to color this tube violet; that is, to superoxidize the manganese which it contained. In truth, this reaction occurs within the glass itself; that is, in conditions much more favorable than the decomposition of iodic acid, in which the radiations passing through the glass alone exert an influence. If the two reactions could be compared, notwithstanding the diversity of circumstances, it might be observed that the easiest reaction is that of oxidation, as might have been foreseen, that is, the exothermic reaction, which facilitates the chemical energies put in action in the system formed by the glass and the air, the radium acting only the part of a determinant (action of atmospheric oxygen), while it is the special energy furnished by the radium which acts in decomposing the iodic anhydride into its elements; that is, an endothermic radiation. This is conformable to the general laws of thermochemistry.

THE PORTLAND CEMENT INDUSTRY IN MICHIGAN.

THE history of the Portland cement industry in Michigan begins, says Prof. Israel C. Russell, of Ann Arbor, in the Annual Report of the United States Geological Survey now in press, with the year 1872, when the Eagle Portland Cement Company built a cement plant about two miles northeast of Kalamazoo. The factory was continued in operation until about 1882, but no traces of the kilns are now in existence. Some three miles of sidewalk were put down in Kalamazoo with this cement, and after 15 or 20 years of use are still in excellent condition. The next factory for making Portland cement was erected by the Peerless Portland Cement Company, in 1896 and 1897, at Union City, and was followed by the erection of the factories of the Bronson Portland Cement Company at Bronson, in 1897, and of the Michigan Portland Cement Company at Coldwater, in 1898.

Portland cement is an artificially prepared substance which has the property of hardening in the air or water when mixed with the suitable proportion of water, and of remaining hard when immersed in water. In its manufacture, a mechanical mixture of finely pulverized limestone or marl and clay or ground shale is calcined, or burned, as the common expression is, and the resulting clinker ground to a fine powder. This is the Portland cement of commerce. In addition to the raw materials, which enter directly into the composition of Portland cement, fuel is necessary for burning them. For this purpose, in upright kilns crushed coke is generally used; and in the rotating kilns a jet of gas, petroleum, or of finely pulverized coal is forced in by means of an air blast. The type of kiln now almost universally used in America consists of a steel cylinder about 60 feet long and 6 or 7 feet in diameter, lined with refractory material. These furnaces are rotated rapidly in a nearly horizontal position. The cement is manufactured by what are known respectively as the "wet" and the "dry" processes. In the wet process the finely ground limestone and clay are mixed with about 60 per cent of water, and this "slurry" is caused to flow into the higher end of the rotary kiln in a small stream. In the dry process the "slurry" is only sufficiently moistened to prevent it from being blown away as dust. As the "slurry" travels down the cylinder, it is raised to a white heat; and the resulting clinker runs from the rotary in a continuous stream of white-hot pellets, which, after cooling, are ground to a fine powder. The cement as it comes from the grinding machines, is of such fineness that from 90 per cent to 98 per cent of it should pass through a sieve having 100 meshes to the inch. It is then ready for use, but usually improves with age.

Portland cement is used in making the foundations for lighthouses, piers, abutments of bridges, for linings of cisterns, and for many other purposes, and a growing use is in the construction of buildings, and especially of dwellings.

The raw materials which enter into the composition of Portland cement thus far used in Michigan are limestone, marl, shale, clay, gypsum and fuel. One of the limestones used is the Dundee limestone, extending in a belt from about 2 to 9 miles wide northeast and southwest across Wayne, Monroe and Lenawee counties in the southeastern corner of the State. The stone is found also at the extreme northern end of the southern peninsula. The best Dundee limestone thus far discovered is extensively quarried at Sibley and Bellevue, near Trenton, in Wayne County, and is used by the Michigan Alkali Company for making Portland cement at Wyandotte. Another group of limestone rocks, the Traverse group, crosses Wayne and Monroe counties in a belt about 2 miles wide, and crosses also the northern end of the southern peninsula from Alpena, on the border of Lake Huron, to Frankfort, on the shore of Lake Michigan. This limestone is utilized at Alpena by the Alpena Portland Cement Company. Another limestone group, the Monroe formation, is extensively quarried in the southeastern part of the State, but its adaptability for the manufacture of Portland cement is doubtful as yet. The limestone of the Michigan series outcrops at Bayport and Sebewaing in Huron County, on the east side of Saginaw Bay on the Charity Islands, at Bellevue in Eaton County, and near the Portage River, 5 or 6 miles north of Jackson.

The marl beds of Michigan occur in abundance throughout the southern peninsula, and are known to be present also to the north of the Strait of Mackinac. These marl beds vary in extent from a few acres up to hundreds of acres, and, in many instances, for an average depth of 20 feet or more.

The shale used by the Alpena Portland Cement Company is quarried about 7 miles north of Alpena and near the shore of Lake Huron. The Cold Water shales are now quarried at a locality about 1½ miles east of Union City, and are utilized by the Peerless Portland Cement Company. The Antrim shales are exposed on the shore of Thunder Bay and also at several localities in Charlevoix County, though they have not, as yet, been used in making cement. The Saginaw shales are found in several mines near Saginaw and Bay City, and at Flushing. The Lake clays of Michigan, suitable for cement making, are distributed about the border of the southern peninsula, for example, between Detroit and Ypsilanti, about Port Huron, South Haven, Whitehall, over the Saginaw Valley, and also in numerous local basins throughout the State; but it should be noted that, in general, the surface clays of the southern peninsula are not well adapted for making Portland cement, although some of the stony clays, if crushed sufficiently fine, may be used for that purpose. It is commonly found desirable to add a small per cent of gypsum to Portland cement clinker before grinding. Michigan possesses extensive deposits of gypsum, particularly at Grand Rapids; and it is from that place that most of the Portland cement factories in this State derive their supply of gypsum.

The fuel used for heating the rotary kilns is usually bituminous coal, which has been thoroughly dried and ground to a fine dust. This dust is driven into the lower end of the kiln by means of an air blast, and on ignition produces a jet of flame some 15 feet long. Both crude petroleum and pulverized peat have been used, but coal dust is regarded as the best fuel.

The Portland cement industry has had a favorable development in Michigan in the last few years. The Bronson and Peerless Portland cement companies began operations in 1897, and by May, 1901, 10 factories were producing cement, and 6 others were in process of construction. The capacity of the 10 plants now built is about 2,400,000 barrels of cement per annum.

The capital stock of all the Michigan Portland cement companies now organized is about $25,000,000, and their estimated capacity is, approximately, 8,600,000 barrels of cement per year. The total consumption of Portland cement in the United States during the year 1900 was between 10,000,000 and 11,000,000 barrels, and the amount manufactured was nearly 8,500,000 barrels. It would seem, then, that Michigan is preparing to supply a demand which does not appear to exist as yet, and as there is a similar activity in this same direction in several other States, it would appear to be evident that the Portland cement industry is in a speculative stage.

THE TELPHERAGE SYSTEM OF ELECTRIC TRACTION.

TELPHERAGE, briefly described, is the automatic transportation of material by electricity. The first attempt to apply electricity to the overhead conveyer seems to have been made in England in 1882 by Prof. Jenkin, to whom we owe the name telpherage. Etymologically the word means far-carrying.

Although the telpher was experimented with as far back as 1882, it was not until comparatively recently that it became a mechanical and commercial success. No doubt the crudeness and inefficiency of the earlier electric motors were probably the cause of the delay in introducing the telpher.

Telphers are used both for overhead and underground work. The present brief article will be confined to a description of the former.

The overhead telpher lines are made preferably of cable, and sometimes of rails. Cables are more commonly employed, simply because the rails are more expensive. The steel running cable employed is carried upon poles between which it is supported at intervals by means of hangers from an upper suspension cable. It is the purpose of this arrangement to prevent sagging. Not far above the running cable, the trolley wire is suspended, and is fixed on the hangers and on pole brackets. If the line is long, current is supplied to the trolley wire by means of feeders at intervals.

The telpher, by which name the electrically-driven carrier goes, is provided with a grooved wheel which runs upon the cable and which is carried upon the motor shaft. In order that it may readily carry both the weight of the motor and of the load, this motor-shaft has a liberal diameter and runs in large bearings. Of all forms of telpher, the most commonly employed for light work comprises essentially two motors, placed one on each side of the grooved driving wheel, and a trailing wheel secured in a stiff frame from which the load hangs. Sometimes two pairs of motors are used, one pair placed on either side of each wheel. Such telphers go by the name of "center bearing," for the reason that the support lies between the motors on the cable.

In some forms the motors are placed only on one side of the cable, their weight being counterbalanced by an electric hoist on the opposite side. In order to prevent a telpher from jumping the cable, the telpher frame is provided with projections which embrace the cable. These projections are employed, not because there is any danger of a telpher's falling to the ground, but simply as a matter of precaution. Just as the telphers vary in height, so do the carriers present differences in form. As a general rule these carriers are hung directly from the telpher or else from a hand or an electric hoist on the telpher. Without enumerating all forms of carriers we may mention the ore-carrier, the earth-carrier, the automatic self-dumping bucket, the hooked carrier for barrels and bags, and the flat carrier for bales and boxes. When the grades are not steep, it is advisable to em-

A TELPHER.

ploy trailers, for by their means the load can be well distributed.

But when the grades are steep, it is of vast importance that a very efficient means be at hand for the quick control of the telpher's speed. For that purpose an electric brake is employed, which is applied automatically to a degree depending upon the grade and upon the telpher's velocity. It is only when the grades are fairly steep that this braking device is required; for the ordinary grade offers no obstacle. Such is the tractive power of the contrivance that grades of thirty per cent have been overcome without any tendency to slip, although the weather was moist.

In mining and lumbering districts, where there is not enough traffic to pay for the construction of a railway, even of narrow gage, the system of telpherage can be very serviceably employed, even though the distance be long. Particularly in mountainous regions are its advantages apparent. The excessive expense of laying a narrow-gage road is avoided; for the telpher can be run on any kind of ground, be it hilly or level. Whatever may be the use to which the telpher is put—and the uses are so many that there are almost innumerable arrangements of the telpherage system—the first step is to distribute the material to be carried among all the telphers. When the line is long, it is customary to divide the total weight among many telphers; and for the return of the empty carrier, the cable is bent into a loop or additional line supported on the same pole, side by side with the forward cable.

On plantations, the trailer finds its widest use. So readily can a large mass of material be distributed between a telpher and several trailers, that the fruit, grain, coffee, or other produce is easily conveyed by trains of telphers and trailers.

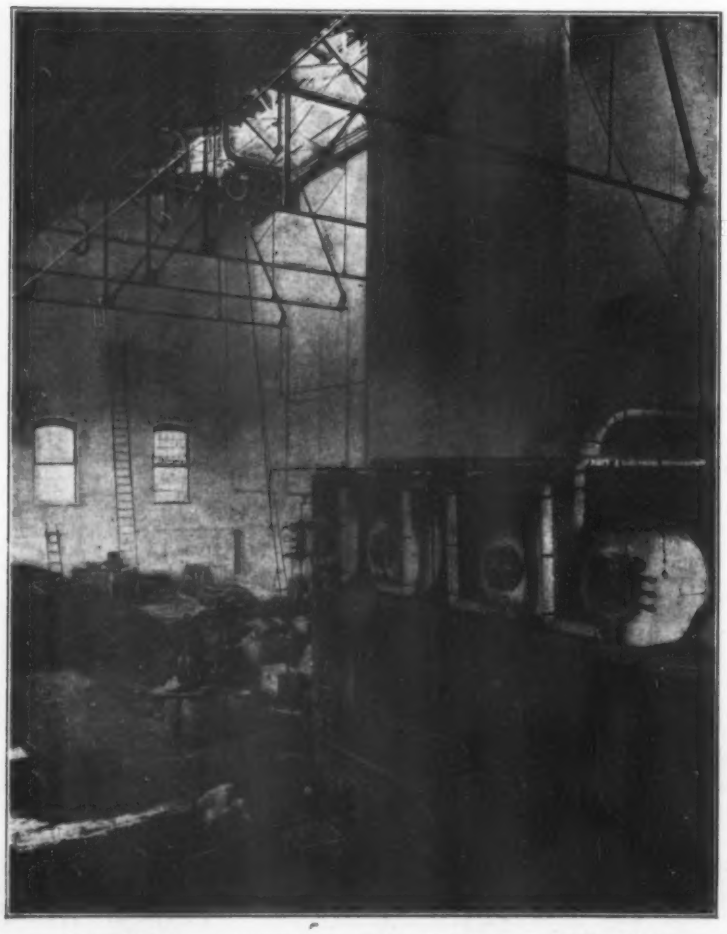
In manufacturing plants the telpherage system is being now widely introduced for the transmission of light loads at a fairly high rate of speed. Ships' cargoes can be quickly transferred from the hold to the warehouse; small castings can be conveyed from one shop to another of a large plant. Especially applicable is the system to the transportation of material from barges along the shore of a river to distant warehouses. How the telpher may be stopped at any desired point is a matter that is probably of no little interest. The trolley wire is divided into sections. Each section is controlled by a switch, by means of which the current is cut off from the corresponding section. Hence when the telpher reaches a cut-off section, it must come to a stop. The simple closing of the switch starts the motors again. In order to cause the telpher automatically to slow down in rounding a curve, it is customary to connect the section at the curve with a resistance by which the voltage across the motors is lowered. After rounding the curve and passing the resistance the speed is automatically accelerated.

The merits of the telpher system are obvious. It is automatic and is entirely independent of surface conditions or obstructions. The speeds attained are high. Curves are rounded at a speed that is not dangerous in any way. These merits combined with the low cost of operation and maintenance will probably lead to the extension of the system's applicability.

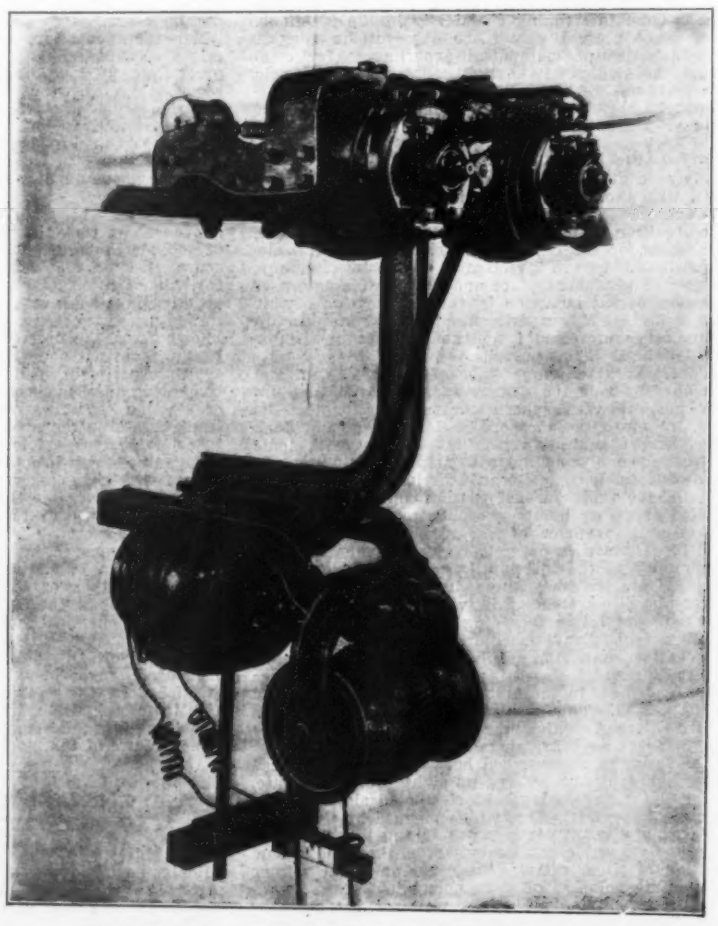
CONTEMPORARY ELECTRICAL SCIENCE.*

CRYSTALLIZATION UNDER ELECTROSTATIC STRESS.—P. R. Heyl has been endeavoring to find some effect of an electrostatic field upon the formation of crystals. The thought underlying the experiments was that if crystals were allowed to form from solutions subjected to strong intermittent electrostatic stress, the crystals

*Compiled by E. E. Fournier d'Albe in The Electrician.

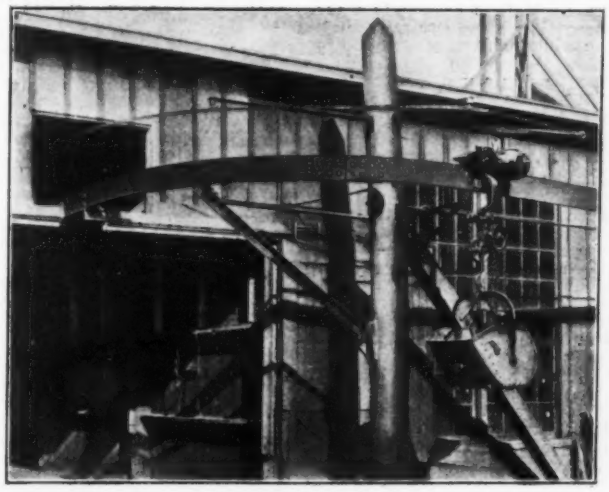


TELPHERAGE SYSTEM IN OPERATION FOR CONVEYING ASHES.



TELPHER ON CABLE TRACK, WITH RAPID-SPEED ELECTRIC HOIST SUSPENDED BELOW.

might, when large enough to be observed, bear some birth-marks which would be interesting or possibly valuable. A change in the interfacial angles seemed the most likely effect, and an alteration of density was deemed possible. Both these effects were looked for, and a salt sensitive to slight mechanical disturbances (HgI_2) was employed as an indicator; but no effect was found. The method of procedure was as follows: A shallow glass crystallizing dish some 8 cm. in diameter, with a flat bottom, was placed upon a sheet of tinfoil. Within this, raised about 0.5 cm. from the bottom was a similar but smaller dish. This second dish was supported in some cases by a wire twisted round its upper part, and in some cases by resting on a bent glass rod laid in the larger dish. The inside of the bottom of the smaller dish was coated with tinfoil. The two tinfoil sheets were connected to the knobs of an influence machine, or to the secondary terminals of an induction coil. The solution under experiment was poured between the dishes after the electrostatic stress had been started. Two solutions were used, viz.: sulphur in carbon disulphide, allowed to evaporate spontaneously, and hot saturated solutions of HgI_2 in alcohol. The author concludes that any molecular forces called into play in a solution under electrostatic stress are not comparable with the forces of crystalline attraction.—P. R. Heyl, Phys. Review, February, 1902.



TELPHER WITH AUTOMATIC DUMPING BUCKET TRAVERSING A CURVE.

VELOCITY OF IONS DRAWN FROM THE ARC.—C. D. Child has made some further experiments on this subject. He employed two methods to compare the velocity of the positive and negative ions, one similar to that used by Zeleny in his investigation of the velocity of ions produced by X-rays, and one similar to that used by Rutherford in determining the velocity of ions produced by ultra-violet light. These methods give the average velocity when there are ions present having different velocities. A new method devised by the same author enables the observer to compare the slowest ions of the positive with the slowest of the negative discharge. The arc is placed in the axis of a cylinder cut transversely into two portions insulated from each other. The arc is at the center of one portion, and the other portion is connected with an electrometer. When the air is at rest the ions move from the arc to the cylinder surrounding it. But if a blast of air is sent through in the direction of the other portion, some of the ions will reach that other portion. The greater the velocity of the ions for the same potential gradient, the smaller is the potential difference necessary to draw them all to the walls of the cylinder surrounding the arc. Another modification of Zeleny's method was made in order to compare the velocities of the fastest ions. In each of the comparisons of the most rapidly moving ions, and also in the comparison of the average velocities, the positive ions were found to have the greater velocity. In the comparison of the slowest ions little difference was found between the two kinds of ions. These results are not in any way surprising. One would have every reason to suppose that from anything as heterogeneous as the ordinary electric arc many different kinds of ions would be produced, so that among the positive ions we might find the most rapidly moving and also the slowest.—C. D. Child, Phys. Review, February, 1902.

A CARBON ELECTROLYTIC INTERRUPTER.—A Wehnelt interrupter using a platinum point in a solution of sulphuric acid has the great disadvantage that when carrying large currents the platinum wears away. A. H. Taylor has, therefore, attempted the substitution of a cheaper material for the platinum anode, and has found that carbon can be made to work satisfactorily. He uses a carbon rod 3 mm. in diameter, and copper-plated to within a few millimeters of the tip. This rod fits loosely in a thistle-tube, which in turn fits the cork of a lead jar and dips into the electrolyte, preferably a solution of caustic potash. The interrupter is made self-adjusting by an ingenious contrivance consisting of a stirrup attached to the bottom of the glass thistle-tube, on which the lower end of the carbon rod rests. As the rod wears away it slides down the thistle-tube, its end always resting on the stirrup. If any cooling device is available, the lead jar may be about 8 cm. high and 3 cm. wide. The minimum voltage required is rather high (70 volts), and the best voltage is about 100.—A. H. Taylor, Phys. Review, February, 1902.

RECOMBINATION OF IONS.—P. Langevin has verified the numerical value of Townsend's recombination coefficient α by an entirely independent method. If ε is the ratio of recombinations to collisions, and k_1, k_2 the mobilities of the ions in an electric field, we have

$$\varepsilon = \frac{a}{4\pi(k_1 + k_2)}$$

The author's method consists in creating a uniform field in the gas between two parallel plates and finding the quantity of electricity induced upon one of these plates at the moment when the field is created; also the quantity collected by this plate after the passage of a single Roentgen discharge, and the quantity liberated in the gas by the radiation, and collected in an infinite field. The difference between the two last quantities is due to the recombination of ions. The author finds that all the values of ε are comprised between 0.26 and 0.28 at 17 deg., even when the thickness of the gaseous layer and the field are varied within wide limits. The ratio ε tends toward unity as the pressure increases. But ordinarily there is one recombination for every four collisions.—P. Langevin, Comptes Rendus, March 3, 1902.

MEDICAL USE OF THE IRON ARC.—The arc playing between iron poles is known to have the peculiarity that the crater is only slightly luminous, and that the chief luminosity proceeds from the gaseous arc itself. A. Broca and A. Chatin have found that it possesses another peculiarity which renders it specially fit for photo-therapeutics—it is the great intensity of the actinic rays when compared with the heat rays. This property makes it possible to bring the diseased part within 8 cm. of an arc of 20 amperes and 35 volts without interposing any cooling device. The absence of water further enhances the actinic effect. The authors have treated nine cases of Willan's lupus with the aid of the iron arc. An exposure of 15 minutes sufficed to produce a marked effect. Some 24 hours after exposure the healthy skin was found not to have been attacked, but the lupus nodules were profoundly altered, and replaced in most instances by excavations about 1 mm. in depth.—Broca and Chatin, Comptes Rendus, March 3, 1902.

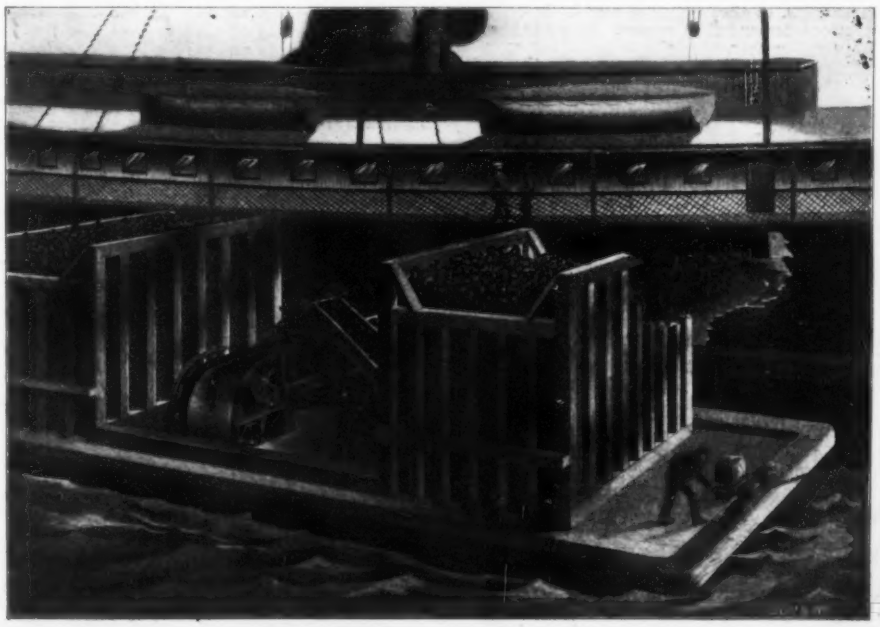
HERTZIAN WAVES FROM THE SUN.—The negative results obtained by Nordmann tend to make it improbable that electric waves of Hertzian dimensions are emitted by the sun, or if they are, that they are transmitted by the atmosphere. It is pointed out, however, by H. Deslandres and Décombe, that the complete solution of the question requires a much larger apparatus and organization than that used by Nordmann. Coherers on the earth's surface receive and indicate various waves whose origin is doubtful, and local disturbances cannot be eliminated except by distributing observing stations over a very large area. This is done in the study of magnetic storms. The fact that ordinary incandescent bodies do not emit Hertzian waves is an argument against the probability of the sun emitting such waves. But besides the body of the sun, its atmosphere, and more especially its protuberances, must be reckoned with. Our own atmosphere emits electric waves during thunderstorms. The great eruptions sometimes noticed in the sun must send out waves of great length, and these should easily penetrate the atmosphere. The authors propose the systematic study of these waves by means of three antennæ normal to each other.—Deslandres and Décombe, Comptes Rendus, March 10, 1902.

EVAPORATION OF ELECTRIC CHARGES.—All experimental data, except those obtained by Pellat, go to show that the evaporation of a charged liquid does not convey away the charge, and the electron theory explains this fact by pointing out that a layer of saturated air in the neighborhood of a liquid surface is much less easily penetrated by ions than a corresponding thickness of air in the neighborhood of a dry metal. Pellat's experiments have been repeated with additional precautions by H. Beggerow, who finds that the complete inclosure of the apparatus leads to errors due to a change in the state of the inclosed air. His own modification of the arrangement consisted in a wire cage connected to earth, and in observing by a different method. The measurements consisted in the determination of the loss of charge of insulated systems, and in an attempt to collect the charges of electricity carried away by particles of moisture. The substances studied include water, alcohol, ether, mercury and various solutions. Positive and negative charges were used in each case, but no influence of evaporation upon the dissipation of the discharge could be detected.—H. Beggerow, Ann. der Physik, No. 3, 1902.

INDUCED RADIO-ACTIVITY.—F. Henning has made some careful experiments with regard to certain conditions determining the intensity of induced radio-activity. The conditions investigated are the dimensions of the body receiving the radio-activity, and its potential. The bodies tested were brass plates or wires, the latter ranging from 0.6 mm. to 6 mm. in diameter. These were mounted in the axis of a closed brass tube which was charged positively, while the wire received a negative charge. The radio-active body employed was thorium oxide, and the exposure lasted 24 hours. The results showed that the thickness of the wire only makes a difference when the difference of potential is small, since then the ions do not readily reach the cathode, and a thick wire facilitates their transfer. When the difference of potential is great, the electric field is powerful enough to bring practically all the ions into the immediate neighborhood of the wire, whatever may be its diameter, in the case of plates from 1 mm. to 3 mm. in diameter. It was found that the radio-activity increased with the thickness. The author also tried to detect an influence of a radio-active substance upon the conductivity of salts, but failed to trace any such influence.—F. Henning, Ann. der Physik, No. 3, 1902.

A FUELING SCOW.

THE accompanying cut shows a fueling scow made by C. O. Bartlett Company, of Cleveland, O., and used for coaling vessels. The arrangement of this machine is as follows: Near each end of the scow are located two large coal-bins, from each of which an elevator carries the coal and delivers it to a belt conveyer mounted in the center of the scow. The elevator is so arranged that it may be driven in either direction, thus carrying coal from either bin as may be desired. The belt conveyer by which the coal is delivered from the scow into the different hatches of the boat is so arranged that it can be carried on the scow, when not in operation. When it is desired to fuel the boat, the scow is moored fast, and, by mechanical devices, the delivery end of the belt conveyer is raised or lowered until it is on a level with the deck of the boat, and rests on the deck by means of two shoes. An engine located on the delivery end is used not only for driving the belt conveyer when it is carrying coal, but also for running the belt conveyer



A NEW MEANS OF COALING VESSELS.

out onto the deck of the boat and returning the conveyer to the scow again.

This conveyer is so arranged that it does not matter to what distance it is run out on the deck of the boat. The belt will always remain tight and can be used in any position. After the boat has been coaled, the engine is reversed and the conveyer is backed to the fueling scow in position to be transported to some other boat. On the rear of the scow is located the boiler with the necessary driving engines. An auxiliary engine operates the elevators leading from the bins. Both elevators and conveyers are large enough to handle any kind of coal, even large lump coal as it comes from the mine.

MODERN TARIFF SYSTEMS.

THIS is the title of a monograph just issued by the Treasury Bureau of Statistics. It presents in concise form a statement of the three distinct tariff systems now applied in the principal commercial countries of the world, and is of especial interest at this time, in view of the tariff discussions and pending tariff legislation in certain European countries. The tariff systems now in use among the prominent commercial countries of the world may be classed under three heads: (1) The general tariff system; (2) the general and conventional tariff system; and, (3) the maximum and minimum tariff system. The system of a general tariff is the simplest of those enumerated, and consists in having a single schedule of import duties, which is applied to the goods of all countries without distinction. Such a tariff is altogether an act of the legislative branch of the government. It takes account only of the needs of the home country, and recognizes foreign commercial relations only in so far as the latter are in harmony with home interests.

The system of general and conventional tariffs, however, makes a distinction between goods which come from different countries. The fact that nations which make use of a general tariff often find themselves compelled to change this tariff when they later make commercial treaties is evidence of how difficult it is to maintain such a tariff intact. But since modern nations are practically compelled to have more or less commercial relations with each other some way of regulating these relations must be found, and the usual method of securing this end is by means of a mutual understanding between the countries in question. Generally one nation declares itself ready to grant some concession or reduction in its tariff if a corresponding concession is offered in return. If an agreement is reached, a treaty is then made, and as a rule the willingness is expressed to make further treaties with other countries under similar conditions. Such a treaty will usually introduce new tariff rates. If the state substitutes these rates for those in the general tariff, then no change in the system takes place. The usual course, however, is for the state to now maintain two columns in its tariff schedule; the first for those countries enjoying the "most-favored-nation" treatment, which is called the treaty or conventional tariff, and the second containing the original rates, for those countries not receiving this treatment, and termed the general tariff.

The rates of the conventional tariff are, of course, never higher than those of the general schedule, and are usually lower. It may be, however, that one nation regards it of importance that a certain rate, a reduction of which is refused by the other power, should not be increased during the period for which the treaty is made. The making of an agreement that rates shall not be changed is termed "binding" such rates. That is, the conventional tariff schedule is composed of reduced and "bound," or fixed rates. The general schedule may be changed at any time without breaking any of the conditions of the treaty, but the conventional schedule can only be changed by the consent of both parties.

The general tariff is framed with the acknowledged purpose of being the basis for the negotiations of commercial treaties. A conventional schedule is drawn up in these treaties, and, by the action of the most favored nation clause, the conventional tariff becomes so extended in application that, as a rule, it is the exception to apply the general tariff. For this reason, the general tariff is regarded mainly in the light of a preliminary sketch of the real tariff. As a consequence, the rates in the general schedule are not infrequently made rather high, so that they can readily be reduced and concessions demanded in return. There is always the possibility, however, that the negotiations may be broken off for some unforeseen reason, and the undesired high rates become actual rates. This possibility generally exerts a restraining influence in the framing of the general tariff. The course which events in the field of commercial policy may take will always exert considerable influence in the formation of such tariff schedules, but the main consideration must always be the needs of the home producers.

The most prominent country using the general and conventional system is Germany. The general tariff is practically that of 1879 with the later amendments. The conventional tariff is made up of the schedules contained in the commercial treaties with Austria, Italy, Belgium, Switzerland, Russia, Roumania, Greece, and Servia. Partially through commercial treaties and partially through the action of the administration in making most-favored-nation agreements, Germany has extended the application of the conventional schedule until it is now given to all European countries except Portugal. The general tariff, therefore, has only a very limited scope, and in this case may be regarded as a penalty tariff. In Austria, the general tariff is based on the laws of 1882 and 1887. The conventional tariff is the result of several commercial treaties and practically applies to all countries of importance.

The maximum and minimum tariff system is distinguished from the above system, first of all, in its form. Instead of having two rates for a few articles, it has two rates on most articles on which duties are imposed, and for this reason is frequently called the double tariff system. In the application of these rates the maximum schedule corresponds to the general schedule and the minimum schedule to the conventional schedule of the system just described, since the minimum rates are given only to those countries which receive the most-favored-nation treatment. The characteristic difference between the two systems, however, arises from the difference in their origin. The minimum schedule is not drawn up by negotiations between the executives of the two countries, but is framed by the legislative body at the same time that the maximum schedule is made. That is, the legislative power fixes two rates of duty on each article in the tariff. The higher rate is the one which fixes the maximum extent to which those articles may be taxed on entering the country; the lower, or minimum rate, is the one which fixes the minimum extent to which the duty may be lowered. If it is desired to make commercial treaties at any time, these two rates show the exact limits between which the treaty rates are to be fixed.

The countries at present using a multiple or maximum and minimum tariff system are Spain, France, Russia, Brazil, Greece, and Norway.

THE HORSE TRADE OF THE UNITED STATES WITH FOREIGN COUNTRIES.

NOT many years ago the impression was quite prevalent throughout the civilized world that an era was approaching when the usefulness of the horse would be greatly curtailed. Extremists went so far even as to forecast a "horseless age." That there were grounds for these predictions, inasmuch as other motive forces were at that time rapidly supplanting animal power, is obvious. In cities, the traction power formerly supplied entirely by horses was giving way, first, to the cable car and, later, to the electric street railway. Afterward, the bicycle and then the automobile gave promise that the application of the principles embodied in these inventions might entirely eliminate the horse from many other phases of urban life. In the country, too, the portable engine, the steam plow, and many economies in the use of animal power suggested the probability of the eventual substitution of mechanical power, to a large extent, for horse power on the farm.

It is apparent now that these gloomy predictions as to the future utility of the horse fell short of fulfillment, having been made on the very eve of a period when Great Britain would have to pay one of the largest bills for horse supplies that was ever paid for such supplies by any nation at any time in the world's history, and when both the horse and mule trade of the United States with foreign countries was to assume a magnitude unprecedented in the history of this Republic.

The present activity, however, of the foreign trade of the United States in horses and mules really dates back to the panic of 1893. The low prices, largely the result of the panic, at which good horses might then be had in this country doubtless had much to do with attracting the attention of foreign buyers to the exceptional advantages of the United States as a source of horse supplies. The result was immediately reflected in the export trade. Exports of horses and mules combined, which in 1893 had amounted to only 4,601 head, valued at less than a million dollars, increased by leaps and bounds until in 1898 they reached the total of 59,248 head, worth $6,841,358.

In the following year the outbreak of the war in South Africa gave an additional impetus to this trade in all exporting countries, especially in the United States, Mexico, Argentina, and Australasia; exports from the United States quickly responded to the increased demand, and in the fiscal year ending June 30, 1900, they amounted to a total of 108,091 head, horses and mules combined, valued at $11,532,094. In the succeeding fiscal year they increased further to the high record mark of 116,655 head, with a value of $12,089,112.

The statistics of the foreign trade of the United States in horses, stated separately, present some very interesting features. The trade naturally divides itself into two periods, the line of demarkation being the year 1894. The first period, extending from 1884, when horses were first separately specified in statements of imports, up to 1894, is characterized by a heavy, though declining, excess of imports over exports, the imports for the entire period averaging annually 42,318 head, against average annual exports of only 2,670 head. The second period, extending from 1895 up to the present time, is, on the contrary, notable for a phenomenal excess of exports over imports, the average annual exports amounting for the period to 46,077 head, against average annual imports of only 6,157. The following statement shows the exports and imports of horses separately for the full period for which figures on imports are available:

UNITED STATES EXPORTS AND IMPORTS OF HORSES.

Year ending June 30.	Exports.		Imports.	
	No.	Value.	No.	Value.
1884	2,721	$424,317	45,610	$3,720,534
1885	1,947	377,692	39,085	3,392,208
1886	1,616	348,323	58,003	4,312,576
1887	1,611	351,607	56,305	4,872,982
1888	2,269	412,744	62,401	5,403,873
1889	3,748	592,469	58,714	4,878,882
1890	3,501	680,410	49,116	4,840,485
1891	3,110	784,908	22,537	3,265,254
1892	3,226	611,188	14,074	2,455,868
1893	2,997	718,607	15,451	2,388,267
1894	5,246	1,108,905	6,166	1,319,572
1895	13,984	2,209,298	13,098	1,055,191
1896	25,126	3,530,703	9 991	662,591
1897	30,532	4,709,265	6,998	464,808
1898	51,150	6,176,569	3,085	414,930
1899	45,778	5,444,342	3,042	551,050
1900	64,722	7,612,616	3,102	599,592
1901	82,290	8,878,845	3,786	985,738

The foreign trade of the United States in mules is entirely an export one. Previous to 1894 the foreign demand for these animals was not greatly inferior to —in fact, in some years it was in excess of—the foreign demand for United States' horses. This trade, like that in horses, began to improve, though not in such heavy proportions, as a result of panic prices, and the recognized value of mules in the army transport service, afterward, upon the outbreak of the South African war, created an extraordinary demand. The following statement shows the total exports of mules from the United States, and, separately, the total exports of horses and mules combined for each year during the past decade:

UNITED STATES EXPORTS OF MULES, AND OF MULES AND HORSES COMBINED.

Year ending June 30.	Exports of mules.		Exports of horses and mules.	
	No.	Value.	No.	Value.
1892	1,995	$238,591	5,191	$849,779
1893	1,634	210,278	4,601	928,885
1894	2,063	240,961	7,309	1,349,956
1895	2,515	186,452	16,499	2,395,750
1896	5,918	406,161	31,044	3,936,864
1897	7,473	545,331	47,005	5,314,596
1898	8,098	664,789	59,248	6,841,358
1899	6,705	516,908	52,523	5,961,250
1900	43,369	3,919,478	108 091	11,532,094
1901	34,405	3,210,267	116,655	12,089,112

Until the outbreak of the war in South Africa the United States export trade in horses was practically confined to two channels: First, the European trade, monopolized almost entirely by the United Kingdom, Germany, and Belgium; and, second, what may be called the North American trade, consisting of exports to countries of the North American continent and its outlying islands. The trade with the rest of the world was unimportant. Until after 1894 the North American trade absorbed the lion's share of our exports. But in the following year an European demand sprang up which increased exports to Europe from 7,972 head in 1895 to 37,377 head in 1900, while the North American trade, the bulk of which was with British North America, increased during the same period from only 5,850 head to 14,045. During this same period, it is true, exports to all the rest of the world increased from 162 head in 1895 to 13,300 head in 1900, but this heavy increase was due almost entirely to shipments of 10,220 head to South Africa and an initial shipment of 2,437 head to the Philippines in the latter year. A more comprehensive idea of the recent development of the United States export trade in horses may probably be obtained from the following statement which gives separately the exports to Europe, to North American countries and outlying islands, to South Africa, and to all other countries combined from 1894 to 1901:

EXPORTS OF HORSES FROM THE UNITED STATES.

Year ending June 30.	To Europe.	To North America.	To South Africa.	To all other countries.
	No.	No.	No.	No.
1894	1,552	3,653	0	141
1895	7,972	5,850	1	160
1896	17,243	7,690	1	192
1897	28,488	10,508	1	595
1898	37,673	12,989	117	371
1899	31,949	12,891	127	812
1900	37,377	14,045	10,220	3,080
1901	24,488	14,842	37,465	5,455

It is thus seen that the extraordinarily heavy exports of horses from the United States in 1901, amounting as they did to 82,250 head, were due primarily to shipments of 37,465 head to South Africa—a larger number of horses, with one exception, than had ever been consigned up to that time to any single destination in the history of our country. If this factor, however, be entirely eliminated from the trade there is still apparent a remarkable and almost steadily increasing demand in both North American and European countries for horses bred and reared in the United States.

The export trade of the United States in mules has been confined—with the exception of shipments in recent years to South Africa, to Hawaii, and to the Philippines—almost exclusively to countries and islands on this side of the Atlantic. Previous to 1900, the Central American States, Mexico, and the West Indies took annually from 65 to 75 per cent of our entire exports, Mexico and Cuba in the latter years being by all odds the most important customers. In 1900, however, although the trade with Central America, Mexico, and the West Indies, as a whole, almost doubled in numbers the proportion which it formed of the aggregate export trade declined to less than 20 per cent, the decline in proportion being due entirely to shipments in that year of 31,014 head to South Africa, 1,260 head to Hawaii, and 1,703 head to the Philippines. It is notable that in the following year the total shipments of mules from the United States were 8,964 head less than in 1900, whereas exports of horses showed an increase of 17,528 head over the year previous. But from the fact that exports of mules, with reference to countries of destination, have not yet been separately stated in reports of the Treasury Department, the cause of this opposite movement between the trade in mules and that in horses is not apparent.

The activity in both the foreign horse and mule trade of the United States continues up to the present time, the former showing further remarkable increase, the latter some tendency to decline. In the eight months ending February 28 of the fiscal year 1901-02, the total exports of horses amounted to 71,438 head, against 51,856 head for the corresponding months of the previous fiscal year, the exports to South Africa aggregating 46,844 head, against 21,342 head, respectively, for the eight-month periods. Exports of mules for the first eight months of the fiscal year 1901-02 aggregated 20,698 head, against 27,595 head for the corresponding period of the year previous. The total exports of horses and mules for the first eight months of the current fiscal year have amounted to 92,136 head, valued at $9,098,863.

WHEAT.

WHEAT is what the naturalist calls cereal grass, and belongs to the same family as oats, rye and other grain raised upon slender stalks. Wheat, however, is considered the most valuable of these grasses, as it can be used in such a variety of ways for food, for even the stalk is of value. It is a native of the temperate zone, although it has been grown in tropical countries, but on high land where the temperature is lower than in other sections.

Because it is so hardy, many millions of acres are planted with the cereal, and it is raised by nearly every civilized nation.

The fields in Russia alone cover about 30,000,000 acres, the French farms aggregate 17,000,000 acres, while the Australian fields cover from 5,000,000 to 6,000,000 acres. One of the greatest wheat-growing countries in the world is the Argentine Republic, where about 3,000,000 acres are planted yearly. The United States and Russia lead the world in the cultivation of this staple, the acreage in this country ranging from 40,000,000 to 50,000,000 acres yearly.

When analyzed or separated into its various parts by the chemists, wheat is found to contain from 60 per cent to 70 per cent of starch, about 12 per cent of albumen, about 1 per cent of oil and traces of gum. The albumen consists largely of gluten. The farmers raise different varieties in this country, although the wheat generally cultivated grows on stalks from three to four feet in height, having ears or spikes three to four inches in length. The bearded wheat is so called from the beard or hair which grows from the spike. Varieties of this wheat are raised in some parts of the country. The grains are of two colors, white and red, the red wheat being found more in the northern part of the United States and in Canada, where the climate is colder. It is more vigorous than the white species, but the yield is not as abundant and the kernel or grain is smaller. White wheat forms the great crop of the farmer in the United States, and is depended upon principally for the white or wheat bread we eat. As the grass will grow in a heavy clay or rich loamy soil, very large tracts of land, such as the broad prairies of the West, are especially adapted to it, and in Kansas, Nebraska, North and South Dakota, as well as Minnesota, can be found wheat farms, some of which are ten and fifteen miles in length. The highest grade raised in this country comes from Minnesota and Manitoba. This is why some of the largest flour mills in the world are situated in Minnesota, those in Minneapolis alone grinding 35,000 barrels in a day.

Wheat is known to the farmer as "winter" and "summer," the winter wheat being sown in the fall, and the summer varieties in the spring. It is only necessary to plow the surface of the field, making shallow trenches with a machine drawn by horses. Then the seed wheat can be dropped into the trenches, or drilled, as it is sometimes called, by hand or by machinery. It is covered over, and in a few weeks begins to spring above the ground in the form of a tender green shoot, the field resembling a plot of grass. With favorable weather it matures very rapidly, and just before it is ready to cut or harvest, presents a beautiful appearance, as the shoots are very graceful and of a rich color between green and gold. The old way of harvesting wheat was to cut it by hand with a scythe or sickle, rake it into bundles and bind them. Most of this work is now done by harvesters drawn by horses, and in some cases, by steam engines. The harvester is furnished with knives and rakes, and not only cuts the grain and forms it into bundles, but actually ties them by machinery, so that the only work required to be done by hand is to place the bundles in shocks or stacks until they are threshed. These harvesters will do as much work in a day as forty or fifty men, and are used almost exclusively on some of the great Western grain farms. Threshing is separating the kernel of the wheat from the stalk. In former days it was done by pounding the wheat with a loose piece of wood, called a fail, but machinery has largely taken the place of this implement also, so that the stalk goes in one end of the thresher and comes out of the other in the form of straw, while the grain drops into a receptacle underneath to be placed in bags ready for the mill.

To prepare the wheat for food, the kernel is broken or crushed in various ways. In many parts of the world it is placed between heavy stones or burrs which have grooved surfaces. By moving one stone upon the other, the kernels are thus broken. Until a few years ago, many of the flour mills in the United States ground the grain between millstones, but the modern mill is operated by what is known as the roller process, patterned after the machinery used largely in Hungary. In the large flour mills of to-day the wheat is first cleaned by being placed in a cylinder covered with wire cloth, where it is brushed by arms which revolve inside the cylinder. These remove the dust and other impurities from the surface of the kernels, which then are passed between pairs of rollers of different sizes. The surface of the rollers is lined or creased in such a way that the grain is broken into pieces ranging from the size of a pinhead to particles of sand, called "middlings," while some of it is converted into the flour of commerce. The flour is separated by machinery from the middlings, into cylinders also covered with wire cloth or silk gauze, while the middlings pass along a conveyor to be again crushed between the rollers. This process may be repeated six or seven times until the miller decides that all of the meat of the kernel which can be secured has been powdered. To separate the flour itself from the pieces of hull which cover the kernel of the grain, it is treated to a current of air, produced by rapidly revolving fans, and the impurities are thus blown from it. The product of the mill is usually sorted into three grades: the "patent," which is the first quality; the baker's flour, which is considered the second, and the bran or low grade. Out of 100 pounds, from 70 to 76 per cent is the patent, 18 to 22 per cent the second grade, while the lowest grade rarely averages over 8 per cent, which shows the efficiency of the machinery employed in the modern rolling mill, as it is termed.

When the Chinese made their bread or cake of wheat 3,000 years before the Christian era, they merely soaked the broken wheat in water, then heated it over a fire. Really bread, as we know it, has been made but a comparatively short period, for unleavened bread was used almost entirely up to the beginning of the present century. The crackers we buy at the bakery are somewhat similar to the unleavened bread we read about in the Bible, for the children of Israel baked their broken grain, after soaking it in water, using no substance to make it light or "raised." Leaven can be made by moistening flour and exposing it for six or eight days in the open air, when it begins to sour and absorb gas. Yeast is merely a substitute for this material, and is mixed with the dough in bread making, to generate the gas which gives the bread its lightness. In modern bread-making two or three different kinds of flour may be blended by the baker. It is mixed with the yeast, water and a little salt, and kneaded into what is called a "sponge." By setting it in a warm place, the yeast begins to ferment, turning the sugar contained in the substance into alcohol and carbonic acid gas. This gas becomes distributed through the sponge, and in trying to escape forms cells, swelling the mass. When the baker thinks the yeast has acted long enough, he adds more flour, water and salt to the sponge, letting it stand one or two hours, when it is ready to be cut into lumps or loaves for baking.

The oven in the modern bakery is heated to a temperature ranging from 450 to 575 degrees, yet the interior of the loaf or sponge is really cooked more by boiling than by baking, as a loaf of good bread actually contains from 30 to 40 per cent of water after the baking is completed. While the heat evaporates a part of the water, it partly boils the starch and gluten in the sponge, turning some of the starch on the outside into dextrine, which gives the crisp, brown appearance to the crust.

In the small bakery the flour and other ingredients are mixed by hand or kneaded, but in the large establishments most of the work is done by machinery, the dough being mixed in large troughs by blades revolving on a shaft or spindle, which is moved by steam, electric, or water power. It is kneaded in masses from which 100 to 500 loaves at a time may be cut. Efforts have been made to invent machinery to slice the sponge into loaves, but thus far they have not been put to practical use. By the modern process it is estimated that 136 loaves of bread of the average size can be made from 100 pounds of flour.

What we call biscuits are merely composed of dough in which milk or eggs may be mixed with a small quantity of baking powder, which acts as the yeast or leaven. The baking powder produces the gas while the biscuits are being heated or cooked, and avoids the necessity of setting the dough to raise. What is known as "aerated bread," which is very popular in England and is used to a certain extent in this country, is merely the ordinary dough raised by carbonic acid gas being forced into it under pressure while the heat is being applied.

Wheat is especially valuable for making bread for the reason that it holds the gas much better than other grains. While rye, oats and corn, as well as other grains, can be baked for food, they do not hold the gas as well, and are more compact—"heavier"—as the cook calls it. Brown bread, sometimes called "Graham" bread, is made of the wheat combined with the bran, but the bran frequently irritates the coating of the stomach, although it contains much nourishment. The macaroni, so popular in Southern Europe, is merely dough of the wheat flour pressed into strings or ropes by being drawn through apertures to give it shape, and then dried by heat from a fire or exposed to the sun. The manufacture of macaroni is one of the great industries in Italy, and in passing through the streets of Naples and some other cities, the traveler can see it spread upon the porches of the houses, thousands of pounds being made in a year by a single family.

From the wheat kernel comes much of the starch used for cleaning purposes, although the largest quantity is manufactured from corn. In securing the starch from wheat, it may be fermented after being mixed with water, and in this way the gluten is separated. Another mode is to knead the floor into dough as in the preparation of bread, then to wash it in a sieve with water, the starch issuing from the dough in the form of a milky liquid, turning into the powder of commerce after the water has evaporated. Starch manufacture is carried on very extensively in Great Britain especially, probably the largest factories in the world using wheat as a base being located at Belfast, Ireland.

The straw, which is thrown from the thresher, can be made almost as valuable as the kernel of the wheat. It is used for filling ticks for bedding, is converted into wrapper paper and pasteboard, and is worn in various forms. The manufacturers of hats and millinery depend largely upon the wheat stalk for their raw material. In this case, however, the stalk is pulled from the ground and carefully separated from the roots and spikes. Then it is slit by what might be called a four-bladed knife, which is pressed along the inside of the stalk, cutting it into even strips, which are sorted into lengths, and then woven or plaited into convenient sizes for shaping into the hat or bonnet. The finest straw comes from the vicinity of Tuscany, in Italy, where the wheat has a reputation for its bright stalk. Here it is grown more for the straw than for the kernel, and the work of plaiting gives employment to thousands of the women and children, most of the plaits being sent to the factories in Great Britain, some coming to the United States. The Chinese also carry on plaiting as an extensive industry, while much of the English material is obtained from Bedfordshire. Thus the few stalks which may grow on ten or twelve feet of ground, and not be worth a dime in their ordinary condition, can be converted by the different processes of manufacturing into an article worth perhaps $20 or $25 when it is shaped, dyed and ornamented with flowers and ribbon, becoming what we call the bonnet.

The first wheat in the United States was planted in New England in 1602, and nine years later in Virginia, which was also the birthplace of Indian corn as we know it. In the period that has elapsed since that time, the wheat fields of this country have expanded, until the yield in 1860 was 260,146,900 bushels. Vast as was this quantity, it had increased until the harvest of 1898 amounted to 530,149,168 bushels—more than double the yield forty years ago. In 1900 the United States farmers raised more wheat than those of any other country in the world—522,230,000 bushels. The Asiatic and European fields of Russia yielded 458,623,000, while France came next with 309,383,000. When the crop fails in the Old World, the United States is largely depended upon to supply the deficiency. This is why wheat forms one of the principal exports of this country. In 1892 we sent abroad 157,280,351 bushels, and in 1897, 146,623,250 bushels, partly on account of crop failures, although the exports of wheat alone have not been less than 50,000,000 bushels within the last five years. The value of the wheat sent to other countries in a single year has been as much as $161,399,132. The price of the cereal has, of course, varied according to the demand, and it has a wide range. In 1899 it averaged between 64 and 80 cents a bushel, according to the season. During 1901 the range was between 63 and 77. This was one of the lowest years in the recent history of wheat growing.

GOOD BEAVER ENGINEERING.

AT the last meeting of the Academy of Sciences a member reported a case of almost human intelligence exhibited by a colony of about thirty beavers in El Paso County, near Palmer Lake, Colorado.

A short distance from the town the beavers had constructed a dam in a shallow creek that fed the reservoir which supplies the town with water. The dam and the beaver houses had been at this point for many years and formed one of the places visited by sight-seers. At length the dam became a hindrance to the settlers who used the water of the creek for irrigation and other purposes. It was necessary to break it so that the water could be utilized. The people on several occasions broke the dam in the daytime and as often would the little animals repair it during the following night.

The beavers, becoming disgusted with the way things were going, decided to migrate to a more secluded spot. They disappeared suddenly, the entire body going away together. They went up the stream about two miles until they found a point where the mountain range could be crossed with comfort. Here they climbed the range and descended into another stream, one mile beyond and constructed a dam.

Dr. J. B. Kinley, the Denver scientist, who went to the scene and made an investigation of the affair, says that he believes that the beavers held a consultation, and before abandoning their old home sent a committee of at least two—perhaps more—out on a reconnoitering expedition. He found evidence in the way of tracks and other things to prove that this precaution had been taken. The scouts went first in several directions and finally hit upon the place to locate and the route thither and reported to the folks at home. He said that the most experienced engineer could not have performed his work with greater skill than did those scout beavers. He did not believe that any of the rodents had ever before been so far away from home and that they discovered this advantageous spot for their new dams and houses as a result of a thorough investigation of the country.

Of all the streams in the country, and of all the points along the stream selected, there is none so eminently suited to the purposes of the beavers as the one they chose. The present abode of the little animals is especially adapted for their work and they have constructed the finest beaver dam ever seen by any student of natural history. The place selected is a point where Nature saved them much work and where they can be protected against the weather and surprise by the enemy.

They went to work in the new field and in a very short time had constructed the dam and erected their houses. The dam is well and strongly built and is pronounced by all who have seen it the finest dam in Colorado to-day. There is less brush and more dirt than was ever seen in a beaver dam before.

A short time after this dam was finished some hunters set fire to the brush and burned out much of it, so that the dam could be broken, presumably to enable them to catch the trout inclosed in the lake. Quickly was this repaired. After a second experience of this kind the beavers rearranged the dam entirely so that the water is allowed to pour over the top of the dam for the entire distance. Thus the brush and wood are kept wet all of the time, so that it is now impossible for the potters to destroy the dam at any point by setting fire to it. This dam is absolutely level on top, is about 500 feet long and incloses about fifteen acres of water.

Several members of the Academy of Sciences of Denver who were interested by the report of Dr. Kinley have visited the dam and they are loud in their expressions of admiration for the remarkable intelligence exhibited by the beavers. Some of them believe there are at least fifty in the colony, while others place the number at about thirty at dusk, when they begin to come out, the doctor having counted about thirty at that time.

From some of the people living in the country the Denver students of natural science gathered information that led many of them to alter their notions in respect to the habits of the beaver. They say that the beaver uses his tail simply as a signal—both of danger and for other purposes. Actual observations made reveal the fact that while at work the beavers obey a boss who signals them either to begin or quit work. The signal is made by slapping the water with the tail. As is known, the signal is also used on the approach of an enemy, whether man or beast. With remarkable alacrity and unanimity the signals are observed by all of the rodents. No evidence could be shown to prove that the tail is used (as is commonly believed) for a trowel to smooth down the mud used in construction.

Prof. Hayes related the method of work on the part of the beaver in the face of danger. Sometimes when persons are near the beavers will discharge work if it

is urgent, such as repairing a broken dam. In such exigency the work is done beneath the surface of the water and ground. It can be seen in the constant appearance of the sticks and brush above water near the point where the dam is broken. This is made possible by the existence of tunnels under the dam and along the edge of the stream through which the beavers bring their material.

Mr. Borchert, of Denver, who watched this mode of work in the face of danger, said that when all the sticks and dirt necessary had been put in place in this manner and it was necessary for the finishing touches to be made, he saw one of the beavers appear and, going to the top of the dam, perform that task alone and with perfect calmness as well as dispatch. He patted the mud, arranged the sticks and rounded up the dam just as well as if it had been done when no danger was at hand. Dr. Kinley believes this beaver had been selected to risk his life in order to do this work.

Some of the trees felled by the beavers, it was found, were as large as a man's leg and were cut down with surprising system and neatness.

The frugality and providence of the beaver was shown in that they had plenty of material always at hand. There were lots of brush and sticks ready to be used in case it was necessary to discharge work in the face of danger, and after an accident to the dam.

The durability of the dam has suggested to the farmers of the State the propriety of raising beavers for the purpose of constructing irrigating ditches throughout the arid sections. The proposition has been seriously referred to one of the irrigation organizations and a plan of procedure in the matter was discussed. It was decided that it was far more feasible than the scheme of the Southerner to train monkeys to pick cotton.

THE FRENCH NAVY.

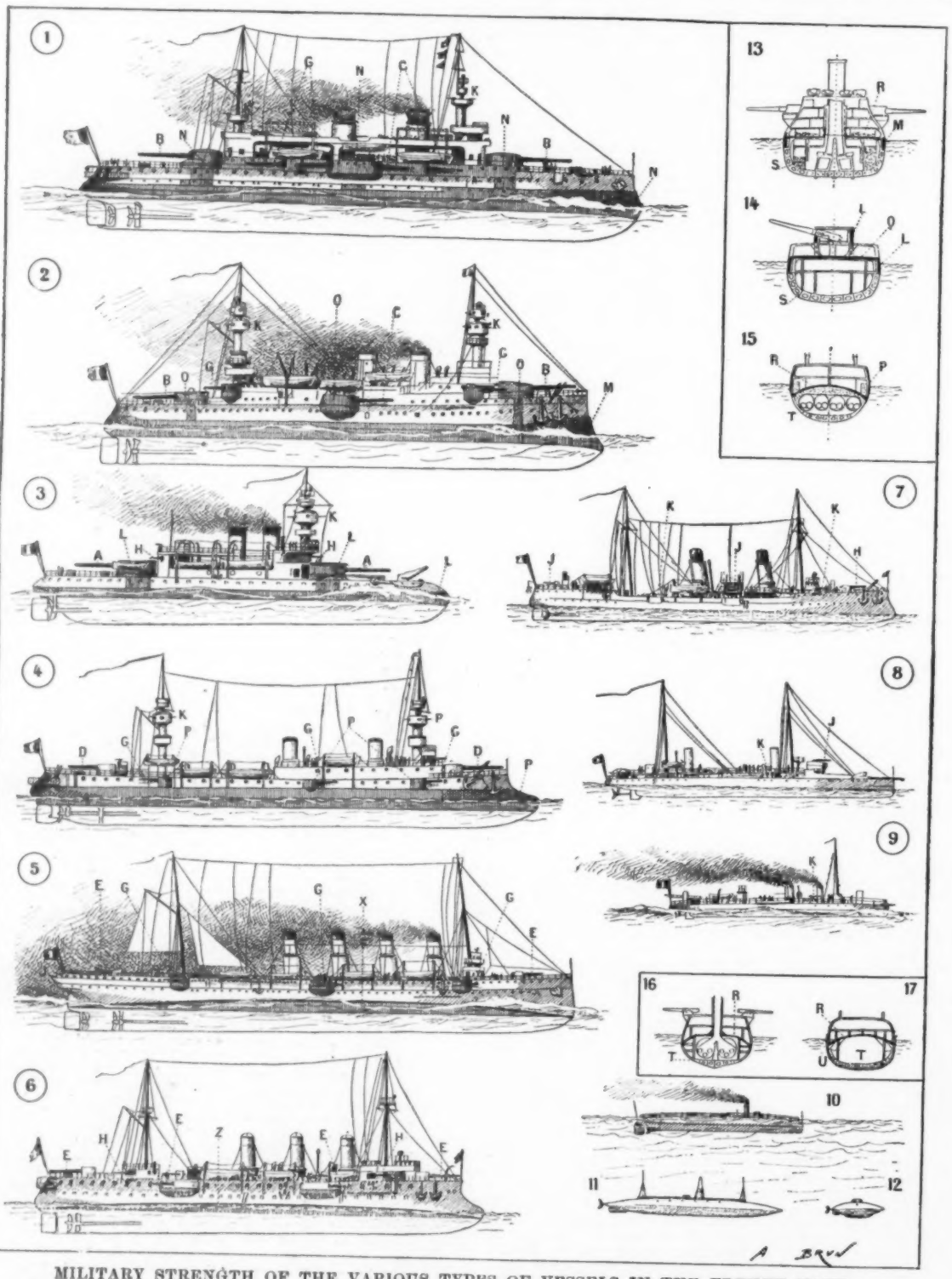
THE offensive military strength of warships consists in their ordnance, torpedoes, and rams. Only the larger vessels are equipped with all three means of offensive action.

The means of defense are to be found in side armor, constituting a more or less complete belt; a protective deck; a double hull, subdivided into stanch cells, or a simple double bottom in smaller vessels; watertight compartments; cofferdams; and pumps for the purpose of keeping the vessel afloat when leaking badly. In the case of the submarine torpedo boat, the water in which the vessel is submerged may be considered a means of defense, since it is a more or less invisible envelop screening the crew from those on board a hostile vessel. Finally, torpedo nets must be mentioned, which are now less used than formerly and may soon be abandoned. The speed and radius of action, that is to say, the horse power of the engines and coal-carrying capacity, may also be considered means of offense and defense.

Every warship is a compromise containing some or all of the elements mentioned. By modifying the weight of the armor, the displacement is increased or decreased, with a consequent influence upon the radius of action. Depending upon their sea-going qualities as well as upon their military power, vessels of war are broadly divided into two classes—armored and unarmored ships.

Armored ships are subdivided into three classes consisting respectively of battleships, coast-defense vessels, and armored cruisers.

Unarmored ships are subdivided into protected cruisers, which have no armor belt, but a protective deck; and cruisers designed for distant stations, such cruisers taking the place of the older types of cruising vessels, and having an outer protective copper-sheathed skin of wood below the waterline, in order to prevent the considerable reduction of speed which must ensue in a vessel far removed from drydocks. Cruisers, as a general rule, serve as scouts for a larger squadron.



MILITARY STRENGTH OF THE VARIOUS TYPES OF VESSELS IN THE FRENCH NAVY.

1. Battleship "Gaulois," 11,275 tons, 14,300 H. P., 18 knots; 2. Battleship "Jaureguiberry," 11,824 tons, 15,000 H. P., 18 knots; 3. Coast Defense Vessel "Valmy," 6,500 tons, 8,400 H. P., 17 knots; 4. Armored Cruiser "Bruix," 4,750 tons, 8,500 H. P., 19 knots; 5. Cruiser "Chateaurenault," 8,300 tons, 24,000 H. P., 24 knots; 6. Second-class Cruiser "Friant," 3,722 tons, 9,100 H. P., 19.7 knots; 7. Aviso Torpedo Boat "Cassini," 954 tons, 5,000 H. P., 21 knots; 8. Torpedo-Boat Destroyer "Fauconneau," 319 tons, 5,200 H. P., 27.5 knots; 9. Seagoing Torpedo Boat "Grenadier," 139 tons, 1,700 H. P., 25.5 knots; 10. Submergible boat "Narval," 105 tons, 8 knots; 11. Submarine Torpedo Boat "Morse," 146 tons, 13 knots; 12. Submarine Torpedo Boat "Goubet." 13. Midship section of a battleship; 14. Midship section of an armored coast defense vessel; 15. Midship section of an armored cruiser; 16. Midship section of a protected cruiser; 17. Midship section of a cruiser for remote stations.

A. 34 cm. guns (13 in.); B. 306 mm. guns (12 in.); C. 274 mm. guns (10 in.); D. 19 cm. gun (7.6 in.); F. 164 mm. gun (6½ in.); G. 14 cm. gun (5½ in.); H. 10 cm. gun (4 in.); J. 65 mm. r. f. gun (2.2 in.); K. 47 mm. r. f. gun (1.8 in.); L. 46 cm. armor (18.8 in.); M. 45 cm. armor (18 in.); N. 40 cm. armor (16 in.); O. 37 cm. armor (14.8 in.); P. 95 mm. armor (3.8 in.); R. 50 mm. armor (2 in.); S. Watertight compartment; T. Cellular double bottom; X. Armor belt of 65 mm. (2.6 in.); Z. Armor, 80 mm. (3.2 in.)

In order to give an idea of the radius of action of some of the more modern vessels, it may be mentioned that the French cruiser "Chateaurenault," as well as the "Guychen," has a coal-carrying capacity of 2,000 tons, whereby they are enabled to cover 10,000 miles at an average speed of 12 knots. Russia, by reason of the enormous distance which separates her Baltic ports from her Asiatic coast towns, has built cruisers of the "Rossia" type, having a coal-carrying capacity of 2,500 tons. The enormous English cruisers "Powerful" and

TABLE OF THE PRINCIPAL MODERN NAVIES.

	Germany.	Great Britain.	Austria.	United States.	France.	Italy.	Japan.	Russia.
BATTLESHIPS								
of a minimum displacement of 12,000 tons and a minimum speed of 18 knots	....	18	....	....	3	4	4	....
of a minimum displacement of 12,000 tons and a minimum speed of 17 knots	....	6	....	12	....	1	....	1
of a minimum displacement of 10,000 tons and a minimum speed of 16 knots	6	9	....	....	12	5	....	7
less than 10,000 tons displacement and having a speed of more than 16 knots	....	5	3	1	5	2	....	6
8,000 tons displacement and less and a speed of at least 14 knots	....	....	....	....	2	....	....	....
	6	38	3	10	22	12	4	14
COAST DEFENSE VESSELS								
of a minimum displacement of 6,000 tons and a minimum speed of 14 knots	12	2	3	3	9	....	....	7
ARMORED CRUISERS								
of a minimum displacement of 4,000 tons and a minimum speed of 16 knots	1	8	2	2	6	4	6	8
PROTECTED CRUISERS								
of more than 2,000 tons displacement and having a minimum speed of 16 knots	21	108	2	22	33	15	14	3
TORPEDO CRUISERS								
of a minimum speed of 16 knots	....	...	6	2	6	15	2	8
AVISOS AND TORPEDO BOAT DESTROYERS								
of a minimum speed of 18 knots	12	137	7	6	22	4	12	18
TORPEDO BOATS								
of a minimum speed of 18 knots	97	16	30	19	144	50	21	52
RESUME.								
Sum total of armored ships	19	48	8	15	37	16	10	29
Sum total of unarmored ships	33	245	45	30	61	34	28	29
Sum total of torpedo boats	97	16	30	19	144	50	21	52
General total of all ships	149	309	53	64	242	100	59	110

"Terrible" have a capacity of 3,000 tons, which, however, does not give them a more extended radius of action, since their consumption of coal is large.

The armament of the various types of ships varies. On heavily armored ships guns of sufficient penetration are carried to pierce the armament of a hostile ship of the same class. Such powerful ordnance would be useless for smaller cruisers, since they can engage only a vessel of their own class or of a lower class. Finally, the form of the vessels likewise differs, the heavy armored ships having greater beam and less length, and the cruisers considerable length and less beam, so that their lines are finer.

Torpedo-cruisers and aviso torpedo boats are two types of vessels which are not known in the American navy. They are light vessels serving primarily as dispatch and scout boats, and as torpedo-boat destroyers.

Torpedo boats, besides carrying the weapons from which they derive their name, are armed with small machine-guns. They have absolutely no protection for their engines and their coal bunkers. A naval constructor of Havre, France, has, however, just finished two torpedo boats of the "Cyclone" type, which are provided with an armor belt of 24 millimeters in thickness and a protective deck of 9 millimeters. The boilers and engines are thereby protected.

Submarine torpedo boats are divided into two groups —submarine boats proper and submergible boats. The latter navigate on the surface as ordinary torpedo boats do when they are not within view of the enemy. When, however, they come within the range of vision of a foe, they are submerged until their upper decks are awash. At the moment of attack they are completely submerged, and then navigate under the surface of the water by means of electric accumulators, which have been charged by their own engines during navigation on the surface. Submarine boats, on the contrary, have no means of recharging their own accumulators. They are compelled to return to some charging station, which may be either a larger vessel or a navy yard. The French submarine boat "Goubet" is of the small type designed for the defense of harbors and anchorages, or to be carried by a larger vessel and to be launched at the moment of action. The submarine boats are armed with torpedoes.

In the comparative table annexed, submarine boats are not included. If they were, France would probably assume a higher place in the list. At the present time France has seven of these vessels in commission and seven others building.

Although there has been a considerable diminution in the weight of armor since the introduction of Harvey and Krupp steel, nevertheless the protective means of vessels are still an enormous factor in the total displacement. The great power of modern ordnance, which is the result not only of improvements in the construction of the guns themselves, but also of the invention of high explosives, has done much to prevent a diminution of the weight of armor. In examining the accompanying table, it must not be forgotten that the speeds given are those attained on trial trips, which are probably never reached in actual service. The smaller types of vessels, such as torpedo boats, avisos and small cruisers, could attain the high speeds with which they are credited only in smooth seas. The small vessel with an official speed of 25 or 30 knots could not probably follow a large vessel making no more than 12 or 15 knots if the sea were particularly rough.—R. Brun and H. Desmarest, in Revue Universelle.

A NOVEL HIGH-DUTY PUMPING ENGINE OF THE COMPENSATING TYPE.

By CHARLES L. HEISLER, M.E.

AT the Cincinnati meeting, May, 1900, of the American Society of Mechanical Engineers a paper was read describing a compensating boiler feed pump having a 7 x 10 x 14 x 10 inch steam end and a 4 x 10 inch duplex water end. This engine showed, as an average of several tests, an indicated horse power on 26 pounds of steam per hour, running non-condensing, with 110 pounds steam pressure at the pump. The results obtained from this small engine were so satisfactory that they justified the construction of an engine having a capacity of 4,000,000 gallons per 24 hours. The latter engine showed the same general characteristics as the small engine, so there was no hesitation in taking orders for 7,000,000, 8,000,000 and 10,000,000-gallon engines.

When working out the design of the 10,000,000-gallon engine shown, the object was to obtain a high commercial efficiency, rather than to secure the greatest possible refinement thermodynamically, without regard to first cost and the maintenance of auxiliaries, necessary for securing the highest thermodynamic efficiency. Steam cylinder jackets and reheaters are omitted on this engine. A Richardson balanced locomotive slide valve is used in the high-pressure steam chest; and plain slide valves are arranged in the intermediate and low-pressure steam chests. The intermediate steam chest is made separate from the cylinder and of cylindrical form for obtaining strength and large receiver capacity. The cylinders are lagged in the usual manner with non-conducting material. Their diameters are 12 inches, 26 inches and 44 inches and 24 inches stroke. The double-acting plunger is 18 inches in diameter.

The compensating mechanism has been fully described in the paper referred to, and consists of two pairs of rocker arms mounted upon the centrally located air chamber, and connected by the floating side rods, one of which is shown in a horizontal position nearest the water end by the general view. The other rod is hidden by the air chamber.

The short slotted bar pivotally connected to the hubs of the rocker arms controls the low-pressure and intermediate-pressure valves, and is connected to the valve stem by a suitable link. The valve lead is changed by moving the pin bearing at the left end of the slotted bar; the cut-off is adjusted by the pin in the slotted end at the right moving it toward or from the rocker-arm center.

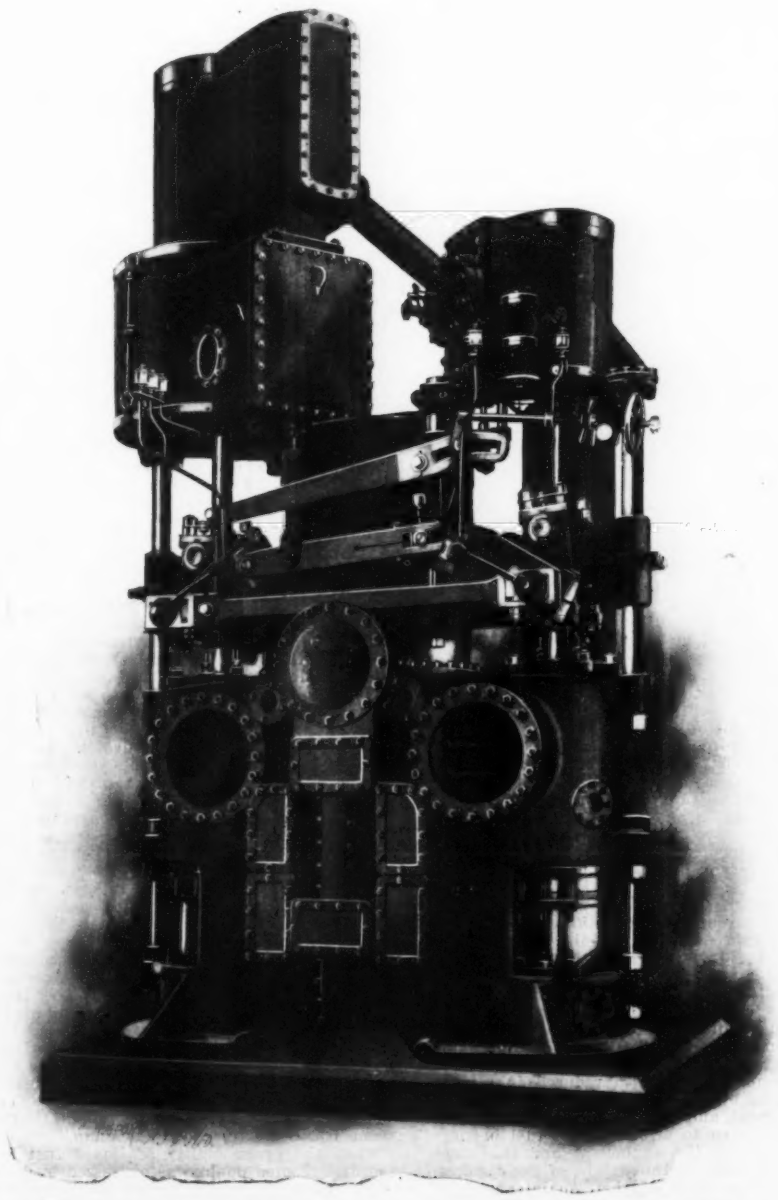
The high-pressure valve gear consists simply of the high-pressure cut-off lever lying nearly horizontal and nearest the cylinder having a curved slot at its right end, which is link-connected with the right-hand rocker arm hub; the left-hand being link-connected to the compensating floating rod as shown. Near the curved slot at the right, the high-pressure cut-off lever is pivotally mounted upon a valve-stem slide of the usual construction, by means of the slot-link block and handwheel shown at the extreme right; the cut-off in the high pressure cylinder may be changed from three-eighths to three-quarters as desired.

Under usual and normal conditions, the compensating floating side rods are in tension, so the main rocker-arm bearings thrust against the air chamber, which is heavily braced inside so as to give a rigid support for the bearings.

The water end may be of any desirable construction, either with inside or outside packed plungers. In such engines it is usual to give each valve deck from 130 to 170 per cent valve area as compared with the plunger area. The water passages have approximately the same proportion of cross section.

Since the stroke is fixed in length and is positive, no trouble is experienced in starting, or when exhausting the air from a long suction line, even when lifting 25 feet. Foot valves are thus unnecessary, and it has been found preferable to have a free and uninterrupted passage from the well to the suction valves; the screens being constructed so one can be cleaned while the other is in service. The two independent suction inlets are at the highest point on the water end, and on either side, there being four suction openings, two for the suction pipe and the two on the opposite side open into large air chambers, one of which is shown back of the high-pressure crosshead.

The valve decks are arranged parallel and vertically.



NOVEL HIGH-DUTY PUMPING ENGINE OF THE COMPENSATING TYPE—CAPACITY TEN MILLION GALLONS PER 24 HOURS.

The four discharge decks face each other and have a common central discharge chamber communicating directly with the large central air chamber above. No flat surfaces are exposed to high pressures excepting the valve decks, which are heavily reinforced, and the narrow strips of exterior walls between decks; a greater portion of their walls being taken up by the twelve manholes and four handhole covers. The small remaining areas are heavily ribbed inside. The larger areas of flat surfaces are on the suction side of the valve decks, and the plunger chamber is cylindrical.

Refined duty tests have not yet been made on this engine. The data obtained, however, shows that the engine will give a steam economy comparing favorably with that from flywheel engines when fitted with slide valves, working triple expansion, and cutting off at from three-eighths to five-eighths stroke in the high-pressure cylinder. Indicator cards taken from the large engine are like those taken from the small engine already referred to.

Engines are now being developed for 15,000,000 to 20,000,000 gallons capacity and fitted with Corliss valve gear. For average conditions and powers under 150 indicated horse power and where simplicity is most desirable, plain slide valves are used. The valve gear, although very simple, gives a quick opening and closing action.

There being no heavy revolving masses requiring large and rigidly supported bearings, as in flywheel engines, it has been found preferable to omit the heavy A frames quite common on such engines, and instead mount the steam end and compensating mechanism directly upon the water end. It requires but little, if any, more time to replace a water end than to remove such a part from between the legs of an A frame. Moreover, it was considered better economy to put an excess of material in the water end, rather than in an A frame, so as to reduce to a minimum the chance of breakage. With rough and continual usage, the bearings do not show undue wear or the slightest tendency to heat.

THE APPLICATION OF LIQUID FUEL TO BATTLESHIPS AND THE COMMERCIAL MARINE.

AT the British Institution of Naval Architects, Sir Fortescue Flannery, M. P., delivered an interesting lecture upon the practicability of utilizing liquid fuel for battleships, and vessels of the mercantile marine. Sir Fortescue Flannery has devoted considerable time to the thorough investigation of the comparative advantages and disadvantages of petroleum for this purpose.

Owing to the immense quantities of oil which are now available in all parts of the world, the question has been resolved into one of great urgency. The British Admiralty has determined to test exhaustively the use of this means of evaporation, and the trials are to be thoroughly carried out not only in destroyers, but also in three cruisers and one battleship. The Italian Admiralty has been pursuing the question for some years. The German Admiralty has used liquid fuel on the China Station for many months in lieu of coal for auxiliary purposes on board ship. The Hamburg-American Steamship Company has fitted four steamers with the necessary appliances for burning liquid fuel, and the North German Lloyd has two vessels similarly equipped. The Dutch navy has fitted liquid fuel apparatus in conjunction with coal on two destroyers, and Dutch mail and cargo steamers in the Far East have liquid fuel in regular use.

The question of safety and flash point is of extreme practical importance. The British Admiralty has hitherto required a flash point of 270 deg. F. Lloyd's Register has required a flash point of 200 deg. F., while German authorities have accepted as safe a flash point of 150 deg. F. Fuel of the lower flash point has been in constant use for four years in British and Dutch mercantile vessels with complete immunity from accident. It is not desirable to fix a flash point higher than is really necessary for safety, because high flash points are obtained by refining the volatile elements out of the liquid to such an extent as to leave a thick and sluggish residuum, requiring large power to pulverize it into spray before ignition in the furnace, and is necessarily more expensive by reason of the additional refining process.

With regard to the employment of liquid fuel upon battleships the problem that confronts the designer of a warship is the combination of the greatest speed, armament and ammunition supply, protection, and range of action, in the smallest and least expensive hull; and any reduction of weight and stowage room of any of the necessary elements of any of these qualities is a great recommendation for the utilization of liquid fuel. The practical figures of comparison between coal and oil fuel realized in recent practice are that 2 tons' weight of oil are equivalent to 3 tons' weight of coal, and 36 cubic feet of oil are equivalent to 67 cubic feet of coal as usually stored in a ship's bunkers—that is to say, if the change of fuel be effected in an existing war vessel, or applied to any design without changing any of the data other than those affecting the range of action, the latter is increased by 50 per cent upon the bunker weight allotted, and nearly 90 per cent upon the bunker space provided.

The coal protection for cruisers, whatever its real advantages—a matter upon which different competent authorities exercise conflicting opinions—disappears with the use of liquid fuel, because the latter for the most part is stowed below the water line, if not wholly in the double bottom. The double bottom and other spaces, quite useless except for water stowage, are capable of storing liquid fuel, and the space now occupied by coal bunkers is thus available for other purposes.

The ship's complement is also reduced to a very appreciable extent by the almost complete abolition of the stoker element, and the substitution of a limited number of skilled men to attend to the fuel burners under the direction of the engineers; and the space of stokers' accommodation, the weight of their stores, together with the expense of their maintenance, is thereby saved. The number of lives at risk, and of men to be recruited and trained over a long series of years, is also decreased without reducing the maneuvering, offensive or defensive power of vessels of any class.

Rebunkering at sea—so anxious a problem with coal—is made easy, there being no difficulty in pumping from a storeship to a warship in midocean in ordinary weather; 300 tons an hour being quite a common rate of delivery in the discharge of a tank steamer's cargo under ordinary conditions of pumping.

The many parts of the boiler fronts and stokehold plates, now so quickly corroded by the process of damping ashes before getting them overboard, are preserved by the action of the oil fuel, and the same remark applies to the bunker plating, which now so quickly perishes by corrosion in way of the coal storage.

Liquid fuel if burned in suitable furnaces with reasonable skill and experience on the part of the men in charge is smokeless. It is easy to produce smoke with it; but this is evidence of its being forced in combustion, or of the detailed arrangements of the furnace being out of proper proportion to each other. In regard to smokelessness, it is, when used under conditions customary in the merchant service, not inferior to Welsh coal, and superior to any other coal ordinarily in use.

The cost of liquid fuel in the East is less than that of Welsh coal, when the cost of transport and Suez Canal dues are added to the original price of the coal as delivered in a Welsh port.

The evaporative duty required from the boilers of destroyers is greater than that required from boilers of any other type; and, while it is possible to burn enough liquid fuel to produce the required duty in boilers hitherto using coal at natural draught, or even at moderate forced draught, difficulty has been found in burning enough oil fuel in boilers of the destroyer type to produce the same effect as that realized under coal at great air pressure. The question of economy of fuel in destroyers when at full power is of comparatively little importance, but the production of the maximum power is essential.

Messrs. Yarrow, of Poplar-on-Thames, have obtained some highly encouraging results with liquid fuel in two torpedo boats built by them for the Dutch government. Their process is to obtain the maximum speed with coal under all usual conditions of forced draught, and then to inject liquid fuel into the furnace above the coal, thus securing additional boiler work while leaving the whole of the grate surface available for coal combustion. The result has been the increase of the maximum speed of each vessel by over one knot per hour. Messrs. Thornycroft, of Chiswick-on-Thames, have also recently made experiments with petroleum fuel, and have obtained the high evaporative duty of 18.95 pounds of water per pound of oil fuel.

In connection with the utilization of petroleum in lieu of coal for liners, and other vessels of the mercantile marine, the former possesses many far-reaching advantages over the latter, especially so far as economy, both as regards fuel consumed and labor, is concerned. In a vessel of this description this factor is of paramount importance. In some instances where petroleum is in use a stoker's and trimmer's crew of thirty-two is now represented by a fireman's crew of eight hands, whose duty, however, is mainly cleaning and helping the engineers with their greasing.

But the greatest commercial gain is the increase of weight and space available for freight. Adopting the proportion of 3 tons of coal as equal to 2 tons of oil fuel, there is a gain in weight of approximately 1,000 tons in the freight of a first-class Atlantic steamer, and again of nearly the whole of the bunker space, which, subject to drawbacks of non-stowage in the hot parts of the bunker space, would be available for measurement freight. Allowing for these, and assuming the storage of the whole of the fuel in the double bottom and peaks, there would be a gain approaching 100,000 cubic feet of measurement made available for freight in such a vessel. The gain from substituting liquid fuel in vessels of less steam power proportionate to the size would be correspondingly reduced, but it may be fairly estimated for most ships that 25 per cent of the space now occupied by coal bunker storage could be utilized for cargo by the transfer of the fuel in a liquid form to the double bottom and other parts not now of any direct use. The cleanliness of oiling instead of coaling passenger ships and the saving of detention at ports of call are obvious.

The provision of storage and pumping ventilation arrangements and of the furnace gear are a disadvantage, both as regards cost and weight, and in some ships trouble and expense has arisen from boiler leakage, consequent upon the presence of water in the oil and the lack of experience of the engineers in firing, etc.; but these difficulties are now disappearing, and latest developments are in the direction of simplicity and less initial cost. Oil fires do not require cleaning, thus avoiding a prolific source of lost speed in ordinary voyage routine.

The furnace arrangements for burning the oil differ considerably, and although there are at present several efficient systems on the market the devices will have to be considerably improved before the maximum effect can be obtained. The fuel is too stiff to be burned except after disintegration, and this is effected either by pulverizing with steam or by injecting the fuel under pressure, so that it breaks itself against an obstacle at the mouth of the furnace or by vaporizing by heat before the furnace mouth is reached. Mr. Howden, the chief engineer of the Great Eastern Railroad of England, who has been burning liquid fuel upon his express engines for some years past, has a modified system by which the fuel is injected into the furnace at the same time as air under pressure, such air having been previously heated by the waste gases in the chimney. This system has been very successfully fitted to the North German Lloyd steamships "Tanglin" and "Packnam."

When the practicability of liquid fuel for vessels was first mooted doubt was expressed by certain shipowners as to the possibility of reverting to coal with facility and celerity if a supply of oil were not available. To satisfy these demands some vessels have been equipped with a convertible furnace. In one of these systems, to change from oil fuel to coal, it is only necessary to swing back the burners quite clear of the fire doors and lay them back against the boiler front; to open the fire doors and rake out all the broken fire-brick; to lay the bars with coal, and to ignite it either in the ordinary way or by means of the oil burners. In the ship "Trocas," which is fitted with a convertible furnace, the change has been effected with commendable facility and celerity while at sea. On one occasion the vessel 28 minutes after steaming full speed under oil was steaming full speed under coal. On the whole, however, experience of long passages is against leaving the firebars in the furnaces while working under oil, and the change from one fuel to the other can at the worst be effected in a few hours.

On this particular vessel the consumption of steam for pulverizing is estimated at 0.2 pound per indicated horse power per hour. Large interchangeable evaporators are fitted as part of the liquid fuel outfit, usually in three interchangeable sections, and when these evaporators have been worked steadily and successfully no ill-effect whatever has shown itself upon the boilers. Two small burners in each furnace are preferable to one large burner, as being more easily adjustable and maintaining continuity of flame without interruption. The loud whirring noise which made the earlier steam burners so objectionable has been quite overcome in burners of recent manufacture.

The system fitted to the Hamburg-American steamship "Ferdinand C. Laeisz" is that known as the Korting system, and does not involve the use of direct steam for pulverizing the fuel. After the water separation in the manner already described the oil is raised by a steam pump, and is heated to about 60 deg. C. by a heater on the suction pipe. It is also filtered before reaching the pump valve. It then passes through the pump and is delivered to another heater, which raises its temperature to 90 deg. C., and at this temperature, and after further filtration, and under a pressure of 30 pounds per square inch, it is injected into the furnaces. In the act of injection a spiral or centrifugal motion is given to the oil by a screwed needle; and this, added to the pressure from the pump, and the softening point effect upon the oil of heating to high temperature, causes the oil to spray and ignite. The firebars are left out, and the furnaces are bricked right round, and air is admitted to the furnaces through perforated gratings, fitted with adjustable covers. This system has been so successful that it has been installed by the Hamburg-American Company upon four other vessels.

FORCED LUBRICATION.

THE subject of forced lubrication was discussed a short time ago by the Manchester (England) Association of Engineers and was opened by a short paper by C. Day. The author said he took it that forced lubrication meant the continuous lubrication of a bearing under pressure, and differed from the system which had been adopted for so many years in connection with the main bearings of Corliss engines of supplying oil to a distributing box, and then letting it run by gravity from that box to a bearing.

Dealing, first, with the advantages of forced lubrication, they had the fact that a film of oil was forced between the surfaces of the bearing at each reversal. He certainly thought that if there was any perceptible play in a bearing, the pressure of oil caused it to be shot into the gap when the reversal took place. The pressure depended somewhat upon the speed at which the engine ran. Another advantage was that the bearings ran quietly without extremely close adjustment. The pressure of oil reduced the tendency to knock. He knew of one engine which knocked distinctly with ten pounds of oil pressure, but did not knock at all at twenty-five pounds pressure. He also held, although it was difficult to obtain figures to prove it, that there was distinctly less friction with being used over and over again. Of course, it had been the practice in mills for many years to use the oil for the main bearings over and over again, but not for crank pins, crossheads, slides, etc. With forced lubrication all oil was so used, so that there was a saving in this respect as compared with ordinary methods.

Another point was the cooling action of the oil on the bearings. There was a very decided cooling action due to the pouring of a large quantity of oil over the bearing. Then again, higher pressure per square inch and higher speeds were permissible. Higher pressure was permissible because of the interposed film of oil and higher speeds, because with the pressure exerted the oil was forced in quickly between the surfaces. As to the disadvantages of forced lubrication, it might be said that the oil pipes under pressure were liable to break through vibration and pressure. This could be remedied by careful design and good workmanship, and possibly by having also an air vessel on the pumps to save shocks on the pipes. Again, the lubrication of the engine was dependent on a pump. Here also it was a question of good design. Experience showed that with valveless pumps there was no trouble, and he was not aware of a single case of breakdown with such pumps.

Another point was that the condition of the oil was liable to alter by repeated use. This particularly applied to poor oils, as imperfect oils with a false body contracted a kind of sediment after repeated use, which affected the lubricating property of the oil. Some oils, too, contained acid which acted on white metals, especially if these had a lead or zinc base. Of course, the remedy was to take care as to the character of the oil they used. Another disadvantage was that with forced lubrication they must thoroughly inclose the engine, owing to the greater amount of oil passed through the bearings, and the consequent greater splash, and this added to the difficulties of securing accessibility. Here again the question of careful design came in. Another point was the accumulation of dirt and grit in the oil. When oil was used over and over again any grit in it was carried to the bearings unless special precautions were taken. By taking the oil to a settling tank and pumping from that, and also using an effective filter, they could get rid of every

atom of grit. Another difficulty was the mixing of water with the oil. To remedy this as much as possible a gland might be put on the cylinder and another on the top of the column.

TRADE NOTES AND RECIPES.

Mikado Perfume.—

Alcohol, 90 per cent	600 grammes
Water	150 grammes
Terpineol	5 grammes
Jessamine	10 grammes
Ylang ylang	3 grammes
Neroli oil	1.5 grammes
Tincture of civet (1 in 10)	10 drops
Vanillin	1.5 grammes
Bergamot oil	3 grammes
Coumarin	2.5 grammes
Lavender oil	2 grammes
Bitter orange oil	3.5 grammes
Tincture of vanillin (1 in 10)	30 grammes
Heliotropin	0.5 gramme
Patchouli extract	20 drops
Spirit of sal-ammoniac	5 drops

—Drog. Rundschau.

Extrait Acacia.—

French acacia	400 grammes
Tincture of amber (1 in 10)	3 grammes
Eucalyptus oil	0.5 gramme
Lavender oil	1 gramme
Bergamot oil	1 gramme
Tincture of musk	2 grammes
Tincture of orris root	150 grammes
Spirit of wine, 80 per cent	500 grammes

—Drog. Rundschau.

Silvering Powder for Metals.—

Silver nitrate	15 grammes
Tartar	15 grammes
Potassium cyanide (poisonous)	7 grammes
Ground chalk	130 grammes

The powder is moistened slightly and then vigorously rubbed on the article to be silvered.—Revue de la Droguerie.

Liquid Naphthol Soap.—

Sapon. domestic alb.	
Sapon. kalini	
Ol. olivar. venal, aa	1.0
Aquæ	50.0
Naphtoli	0.25
Ol. citri	q. s

Dissolve the soap in water, add the oil, shake frequently until the latter has also saponified, which is generally the case within 48 hours and then dissolve the naphthol and lemon oil in the mixture. Finally filter.—L'Union Pharm.

Rouge for Buff Wheels.—The rouge employed by machinists, watchmakers and jewelers is obtained by directly subjecting crystals of sulphate of iron or copperas to a high heat by which the sulphuric acid is expelled and the oxide of iron remains. Those portions least calcined, when ground, are used for polishing gold and silver. These are of bright crimson color. The darker and more calcined portions are known as "crocus," and are used for polishing brass and steel. Others prefer for the production of rouge the peroxide of iron precipitated by ammonia from a dilute solution of sulphate of iron, which is washed, compressed until dry, then exposed to a low red heat and ground to powder. Of course, there are other substances besides rouge which are employed in polishing, as powdered emery, kieselguhr, carborundum, rotten stone, etc.—Pharm. Era.

Asbestos Cement.—Ground asbestos may be made into a cement which will stand a high degree of heat by simply mixing it with a solution of sodium silicate. By subsequent treatment with a solution of calcium chloride the mass may be made insoluble, silicate of calcium being formed.

A cement said to stand a high degree of heat and to be suitable for cementing glass, porcelain, or other vessels intended to hold corrosive acids, is this one:

1. Asbestos	2 parts
Barium sulphate	3 parts
Sodium silicate	2 parts

By mixing these ingredients a cement strong enough to resist the strongest nitric acid will be obtained. If hot acids are dealt with, the following mixture will be found to possess still more resistant powers:

2. Sodium silicate	2 parts
Fine sand	1 part
Asbestos powder	1 part

Both these cements take a few hours to set. If the cement is wanted to set at once, use potassium silicate instead of sodium silicate. This mixture will be instantly effective, and possesses the same power of resistance as the other.—Pharmaceutical Era.

Oil of Spike.—The oil obtained from spike lavender is sometimes called briefly oil of spike, the distillates of other species having also been known by this name. The oil from "true" lavender (Lavandula vera) is known simply as oil of lavender. An "oil of spike" which has been more or less used in this country is a very different substance, a mixture of Barbadoes tar dissolved in spirit of turpentine in varying proportions, and sometimes American petroleum is added. An ounce or two of the tar to a pint of turpentine is an average proportion.

In late years formulas have been published for a so-called oil of spike containing sulphuric acid, whale oil, oil of juniper wood, oil of origanum, and perhaps other ingredients in addition to those given. Such a preparation may be classed as "Smith's oil."

It should be remembered that there is danger in mixing strong acids with turpentine or other essential oils. It should always be done in an open vessel, adding the acid in small portions and allowing the reaction to end before adding a new portion.

The artificial "fruit essences" are of doubtful standing from a hygienic point of view. They have been largely superseded by the real fruit juices which are now easily obtained.—Drug. Circ.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

American Vehicles Desired in Madagascar.—In continuation of my report of December 4, 1901, on the subject of "Roads and Transport Systems in Madagascar,"* I would say that the French government has awarded the transport service between the coast and Tananarivo to Mr. Edouard Giquel, a merchant of long standing in this country.

Mr. Giquel, who has studied the different patterns of handcarts and "pousse-pousse" used in the last two years, has come to the conclusion that the strongest, lightest, and most durable vehicle of the kind can be produced in the United States; and, consequently, he is desirous of entering into correspondence with our wagon and carriage manufacturers in order to obtain something of purely American type.

The weight and dimensions of the pattern of pousse-pousse which has displayed the most favorable characteristics are:

Weight of carriage, without wheels	92 pounds
Diameter of axletree	1 inch
Radius of wheels	18 inches
Weight of wheels	44 pounds

It is creditable to our manufacturers that the first wheeled vehicles to carry goods upcountry here were American, and that these wagons have stood the test of wear better than any others, and have given entire satisfaction to the owners. This ought to be an incentive to compete with the passenger pousse-pousse and other vehicles destined to do away with transport by men's shoulders.

In order to make clear to our manufacturers what is wanted, I will briefly review the points to be kept in mind. The road to be worked over from the coast to the capital is 150 miles long; its final elevation is 4,000 feet above sea level, but a vehicle has to descend a great many times before reaching the capital, owing to the mountainous nature of the country. So far, the French have not produced an article that will stand the strain for any length of time; the fact that France possesses beautiful roads is perhaps the reason her manufacturers do not readily lend themselves to the construction of a vehicle that has to fulfill new conditions. Questions under discussion are whether rubber tires should be employed, and whether the wheels might not be enlarged; but the chief difficulty is to devise means by which the center of gravity of the body of the cart, when loaded or occupied by a person, can be kept near to the axletree. Unless this can be maintained at an almost constant quantity, the constant ascending and descending creates a vertical leverage, to counteract which enormously diminishes the traction force and impedes speed, consequently, the pousse-pousse has thus far obtained little advance over a palanquin in matter of speed.

Our manufacturers desirous of taking up the matter should write in English or French to Mr. Edouard Giquel, Tamatave, who will explain all further details. —William H. Hunt, Consul at Tamatave.

Belgian-United States Trade.—The time is now ripe for a general move for the markets of this part of Belgium. Business is improving, and the people are friendly toward American goods and readily recognize their merits. I believe an active campaign by a few up-to-date salesmen would be the means of greatly increasing our sales here.

In no line is this more apparent than that of machinery. Manufacturers have realized that they must have modern machinery and tools in order to keep pace with their foreign competitors; and now that the trade outlook is brighter, they are casting about for installations of the latest and best. Not only good salesmen to sell the machinery needed, but competent American workmen to superintend its placing and operation.

During the past year, substantial progress has been made along all lines at Liege, but there is still room for more.

This part of Belgium also continues to increase its sales to the United States, as the following figures show: During the last six months of 1901, the exports from this consulate to the United States amounted to $891,641.15, against $768,464.83 for the same period for 1900 and $663,231.04 for 1899; while for the first two months of 1902, they amount to $226,313.68, against $159,199.18 for the same period of 1901 and $142,716.30 for 1900. This gain was nearly all in firearms, of which gun barrels, rough bored, represent an important part, being $52,230.67, against $41,516.49 last year notwithstanding the reduction in price of the same grades of barrels, which averages about 10 per cent.

The kind of gun sent to the United States is undergoing a material change for the better, as but few of the cheaper steel barrels are now shipped, while the Damascus barrels, which are a specialty of this locality, are increasing. The gun-barrel manufacturers are agitated just now because of the threatened enforcement of an old law—a dead letter for several years—which provides that all firearms and parts leaving Belgium shall carry the Belgian government proof mark. This will add from 10 to 15 per cent to the cost; besides, many of the lighter weight of barrels made for the United States will not stand the severe Belgian test. Should this law be enforced, it will materially affect the export trade.

During February, there was shipped to the United States 675 tons of steel rails at $19.21 per ton. These are the first that have been shipped from here in years, but the parties making the shipments inform me that they expect to continue for some time.—Alfred A. Winslow, Consul at Liege.

Tax on Commercial Travelers in British Guiana.—At a session of the colonial legislature, held in this city March 12, the local tax ordinance being under consideration, a motion was made and adopted imposing a tax of $48 on all commercial travelers taking orders for goods.

A few of the elective members of the legislature, prominently associated with the mercantile interest of the colony, were chiefly responsible for the incorporation of this clause in the ordinance. An effort was made to make the tax £50 ($243), which would tend still more effectually to keep out the foreign business agent. The official members heartily supported the measure as finally adopted.

The ordinance will prove mischievous by limiting the commercial horizon of the colony, handicapping business intercourse, and checking the development of trade. It will discourage one of the most popular and successful methods available for promoting our commercial relations with the colony, by embarrassing our exporters as well as the local retail merchants.

Many of the smaller retail firms which formerly made their purchases through local jobbing houses, which have their resident purchasing agents in England, had gradually found it advantageous to deal with the commercial travelers, who kept them in touch with foreign markets and offered competitive prices, which promoted their success in business. The local jobbing concerns, which are quite independent of the commercial traveler for the reason stated, expect, under existing conditions, that the retail concerns will resume their former business relations with them.

While the ordinance applies to England as well as the United States, it will, I think, be clear that it will practically operate to our disadvantage.—George H. Moulton, Consul at Demerara.

Cement in Paraguay.—There is a large consumption of Portland cement here, as most of the houses are built of brick. One house alone sells about 48,000 barrels per year. Frame houses are not liked in this country, because they afford hiding places for all manner of insects. People here build their walls exceedingly thick, on the principle that both heat and cold are thus excluded; they also cover the houses on the outside with cement.

The chief brands coming to this market are: Aguila, which comes in barrels of 120 kilogrammes (264 pounds) and costs $1.50 and $1.60 laid down in Buenos Ayres; Cardinal, which comes in barrels of 100 kilogrammes (220 pounds), and costs $1.70 gold; Leon, which comes in barrels of 100 kilogrammes, at $1.65 gold; Pato, in barrels of 100 kilogrammes, at $1.50 to $1.60. This last class is quite inferior, and does not seem to be popular in this market.

It is a great deal better to send heavy material like this to Buenos Ayres, sending shipping documents to a trans-shipping company and advising it by previous letter (in Spanish) of the steamer on which the shipment is made, so that the lighters may be ready. These lighters remain in the port of Buenos Ayres perhaps six or eight days, awaiting a steamer for Asuncion. The freight on such a cargo boat is $2 less than if the goods are shipped on one of the passenger boats.

I understand that some of the New York lines have arrangements with the Mihanovich Steamboat Company to trans-ship their cargo on a river steamboat, which is as cheap as obtaining a through bill of lading from New York.

The usual term of credit here is six months.—John N. Ruffin, Consul at Asuncion.

Proposed German Tariff and Swedish Joiners' Industry.—Considerable quantities of joiners' manufactures—doors, sashes, etc.—are exported from Sweden to Germany. They have hitherto had to pay a duty of 3 marks (71 cents) per 100 kilogrammes (220 pounds). The new German tariff proposes to increase this duty to 10 marks ($2.38). The directors of the Swedish Export Union have addressed a memorial to the Swedish government, stating that such a rate of duty would almost exclude them from the German market.

The average price of the principal article—doors—is 10 marks ($2.38), less 33 1-3 per cent discount, or hardly 7 marks ($1.67) net. The doors average in weight 3½ to the 100 kilogrammes (220 pounds) and cost about 24.50 marks ($5.83).

Of the total Swedish export of joiners' material (valued at 5,340,000 crowns, or $1,431,120, in 1901), 2,460,000 crowns' ($659,280) worth went direct to Germany, and a considerable portion of Sweden's export to Holland and Belgium was re-exported to Germany. It is further stated in the memorial that it appears impossible for the Swedes to find new markets to offset the loss of this one. In England the sale of Swedish building material has become less every year, owing to American competition.

The proposed German tariff will not injure American industries alone. One hears talk of reprisals from several lands whose export trade to Germany is menaced.

Germany, some writers insist, may find difficulty in concluding satisfactory commercial treaties, if the proposed tariff becomes law.—Thomas Ewing Moore, Consul at Weimar.

* Advance Sheets No. 1276 (February 26, 1902).

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The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

SELECTED FORMULÆ.

More Veterinary Formulæ.—

For colic in horses:

Spirit nitrous ether	28	grammes
Tincture opium	28	grammes
Tincture aconite	1.18	grammes

To be given in half a liter of water and repeated if necessary in half an hour.

For worms in horses:

Powdered areca nut	60	grammes
Powdered gentian root	60	grammes
Iron filings	30	grammes

Divide into twelve powders. A powder is to be followed by an emulsion of oil of turpentine, 56 grammes; soap solution, q. s. to make an emulsion.

Tonic condition powder for horses:

Powdered nux vomica,		
Powdered ferr. sulph., of each	30	grammes
Gentian root	45	grammes
Aromatic powder	15	grammes

Divide into twelve powders.

Diuretic powder for horses:

Resin	90	grammes
Potassium nitrate	90	grammes
Buchu leaves	45	grammes

Divide into twelve powders.

For harness or saddle galls and bruises:

Tannin	12	grammes
Alcohol, q. s. to dissolve.		
Boric acid	90	grammes
Glycerin, q. s. to dissolve.		
Water to produce	168	grammes

To be applied twice daily.

For fistulæ:

Zinc chloride	30	
Distilled water	28	

Two days after the application of this solution, the fistula should be syringed with the following:

Creolin	7
Distilled water	448

For cracked heels:

Zinc oxide	3	
Carbolic acid	0.60	
Lard	30	

—Apoth. Zeit.

Brooke's Ointment.—This ointment enjoys a wide reputation among skin specialists for catarrhal lupus:

Zinc oxidi	2	drachms
Pulv. amyli	2	drachms
Vaselini albi	½	ounce
Hydrarg. oleat. (5 per cent)	1	ounce
Acid salicyl	20	grains
Ichthyol	20	minims
Ol. lavandulæ	q. s.	

—Chem. and Drug.

Mist. Tussi Rub.—There is no uniform formula followed for this in London. The Brompton cough mixture is a safe red one, but you may with advantage modify it as follows:

Tr. scillæ	1½	drachms
Liq. morph. hydrochlor	1½	drachms
Syr. tolutani	1	ounce
Inf. rosæ ad	6	ounces

M. Dose: A tablespoonful three or four times a day.—Chem. and Drug.

Barber's Powder.—

Corn starch	5	pounds
Precipitated chalk	3	pounds
Powdered talc	2	pounds
Oil neroli	1	drachm
Oil citron	1	drachm
Oil orange	2	drachms
Extract jasmine	1	ounce

Lemonade for Diabetics.—The following is said to be useful for assuaging the thirst of diabetics:

Citric acid	1	gramme
Glycerine	50	grammes
Cognac	50	grammes
Distilled water	500	grammes

—Med. Times.

Rose Talc.—

Powdered talc	5	pounds
Oil rose	32	drops
Oil jasmine	4	ounces
Extract musk	1	ounce

Tea Rose Talc.—

Powdered talc	5	pounds
Oil rose	50	drops
Oil wintergreen	4	drops
Extract jasmine	2	ounces

Violet Poudre de Riz.—

I.

Corn starch	7	pounds
Rice flour	1	pound
Powdered talc	1	pound
Powdered orris root	1	pound
Extract cassie	3	ounces
Extract jasmine	1	ounce

II. (Cheaper.)

Potato starch	8	pounds
Powdered talc	1	pound
Powdered orris	1	pound
Extract cassie	3	ounces

Preparations for Use in Lupus and Cancer.—Ponchet's formula for a painless escharotic for use in lupus and cancer is as follows:

Arsenious acid	2 parts
Orthoform	2 parts
Alcohol	100-150 parts
Water	100-150 parts

Mix.

UNNA'S GREEN PASTE FOR LUPUS.

Acid salicylic	1 part
Liquor antimony chloride	1 part
Creosote	2 parts
Extract cannabis indica	2 parts
Adeps lanæ	4 parts

Mix and make a paste. —Pract. Drug.

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